DOCUMENT RESUME

ED 196 713 SE 033 694

AUTHOR	Warfield, John N.
TITLE	Designs for the Future of Environmental Education, Volume I. Final Report.
INSTITUTION	Virginia Univ., Charlottesville. School of Engineering and Applied Science.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Office of Environmental Education.
REPORT NO	UVA/522032/EE80/127
PUB DATE	Jul 80
CONTRACT	300-700-4028
NOTE	149p.: Appendix 2, pages 117-124 "Systems Planning for Environmental Education," removed due to copyright restrictions.
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	Community Programs; *Environmental Education; Instructional Systems; *Models; Planning; Program Development; *Program Implementation; *Regional Programs; *Systems Analysis; Systems Approach
IDENTIFIERS	Regional Environmental Learning System

ABSTRACT

Reported is one of a series of research and development efforts at the University of Virginia sponsored by the U.S. Office of Environmental Education. These projects are intended to produce approaches, methods, and basic resources needed to improve local capabilities in environmental education program design and implementation. Presented in this report are: (1) an analysis of the requirements of environmental education, (2) a series of organizational models, (3) a description of how existing resources apply to the models developed, and (4) an outline of an approach to evaluation. Various systems methodologies are employed to integrate the program components being considered. To test and refine the products developed, a comprehensive Regional Environmental Learning System is recommended. (WB)

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DESIGNS FOR THE FUTURE OF ENVIRONMENTAL EDUCATION

VOLUME I

FINAL REPORT
CONTRACT NO. 300-700-4028

Submitted to:

OFFICE OF ENVIRONMENTAL EDUCATION
DEPARTMENT OF EDUCATION
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REPORT NO. UVA/522032/EE80/127

JULY 1980

SE 033 694

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DESIGNS FOR THE FUTURE OF ENVIRONMENTAL EDUCATION

FOREWORD

October, 1980, marks the 10th anniversary of the Environmental Education Act. In 1970 Congress determined "that the deterioration of the quality of the Nation's environment...is in part due to poor understanding of the Nation's environment and of the need for ecological balance; that presently there do not exist adequate resources for educating and informing citizens in these areas, and that concerted efforts ...are therefore necessary."

Environmental Education was defined by Congress as a process involving the study of the relationships that exist between the natural and social support systems that, together, constitute the "total human environment" and define the quality of life.

> "Environmental education means the educational process dealing with man's relationship with the Earth and his affect on the Earth and his relationship with his natural and man-made surroundings, and includes the relations of energy, population, pollution, resource allocation and depletion, conservation, transportation, technology, economic impact, and urban and rural planning to the total human environment."

Its purpose is the improvement of individual and societal capabilities in decision-making that require knowledge and consideration of interacting policy, social, economic, values, environmental, and technological factors and needs.

The definition emphasizes the interdisciplinary nature of environmental education and, in that regard, the need for the articulation of content (the relationships) and process (learning approach) in an appropriate context. It was recognized that development of resources that are responsive to the need would require the invention of ways to synthesize and effectively communicate relevant knowledge from the various disciplines and subject fields.

Two distinct but related classes of problems had to be addressed if learning opportunities of the type sought were to become generally available. One encompasses the substantive concerns related to the scope and interdisciplinary requirements of environmental education. The other class can be described as "institutional" or "system" concerns that are related to the implementation and delivery of improved educational practices in general.

The strategy pursued by the environmental education program consists of two levels of research and development and two operational phases. In Phase I priority was given to research and development of generic resources. The first level of research and development was directed to the substantive needs of the field, with emphasis on conceptual frameworks to guide the development and treatment of social-natural system topics in an interdisciplinary way. The second level of research and development focused on the delivery of interdisciplinary environmental education in operational settings and, thus, on institutional/system concerns related to implementation. It is widely acknowledged among practitioners and researchers that education change cannot be meaningfully addressed without an understanding of the specific characteristics, constraints, barriers and opportunities present in the system involved and an appreciation that each system is unique in many respects. For this reason the development of models and processes to facilitate local efforts to design and implement programs was emphasized.

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In 1980 Phase II of the program strategy was initiated. This phase represents the transition from the generic to the specific, with emphasis on dissemination, training and technical assistance in the use of the generic resources in local program design efforts.

The project conducted by the University of Virginia, Charlottesville, (UVA) was one of several major research and development efforts sponsored by the Office of Environmental Education during Phase I of the program strategy. UVA, in collaboration with six other universities and education research organizations, developed generic resources needed to improve local capabilities in program design and implementation.

Among the resources developed was a normative model of environmental education that was derived from the Environmental Education Act, analysis of selected resources, and discussions with practitioners. The model was used to assess the current state-of-the-art, to identify major design and implementation needs, and to guide the development of processes, methods and resources that can help meet the needs.

Substantive Needs

Interdisciplinary education has some unique requirements that are, in many respects, more challenging than those associated with the traditional disciplines. It is also an area of education in which experience has been very limited.

In interdisciplinary education it is necessary to work with relationships among components of content that traditionally have been viewed as disparate and treated in a categorical way within specific disciplines. Another, related problem in interdisciplinary environmental education is its relatively broad scope which necessitates the use of specific contexts that can provide focus and coherence without diminishing the scope and, as a consequence, precluding realization of the cognitive requirements and objectives of the field. Contexts which meet these needs will also facilitate determination of appropriate types of relations to be used for selection, organization and study of the components of content, and will help assure the relevance of the learning experiences for the learner.

The overall context and scope of environmental education is "the total human environment" which includes people; the natural support system and its resources; the social support system which includes the artifacts created by humankind; and the results of the interactions and interdependencies among these elements. An example of a more specific context that is responsive to the overall scope and context of environmental education and that can effectively facilitate substantive content development is the theme "human settlements" viewed from a regional perspective. The size and boundaries of a region would be defined by factors that are specific to each project. This would include the optimum geographic area for observation of the interacting environmental, economic, policy and social factors that characterize the theme, and for relating it in an immediate way to the lives of the learners.

Finally, a context that is appropriate will be supportive of the values and mission of interdisciplinary environmental education. The values associated with environmental education are fundamental to American education in general, in which learning as distinguished from conditioning is sought. The concomitant mission of environmental education is that of helping the learner acquire the knowledge and skills required to explore issues or themes, to understand alternative choices and their implications, and to make responsible decisions. It does not seek to transmit predetermined attitudes or to advocate particular positions or choices. Nor does it emphasize affective at the expense of cognitive learning. The learner and his/her overall development as a functional and responsible member of a democratic society is the central concern. An inappropriate context -- one that is too narrow or too broad, for example -- usually results in a change in values and mission with conditioning, advocacy and disregard for the functional needs of learners predominating. These and other problems related to inappropriate context generally occur when a component of the content of environmental education (e.g. energy, population, pollution, natural resource allocation and depletion) is substituted for the context (total human environment), when the relationships among the various components are not given adequate consideration, or when general "awareness" or "appreciation" is substituted for knowledge and skills development.

The individual disciplines are, by definition, more narrow in scope and for the most part have delineated a context and content that are not dependent upon location or situation for validity, meaningfulness or utility. The specific elements of content used in an interdisciplinary environmental education program, however, should be based on the specific context selected which, in turn, should be determined by the program's location, situation and target group. Since the context and content will vary among programs, the design of specific learning experiences should be locally initiated with special attention given to local interests, opportunities and needs as well as the generic substantive requirements of the field.

Institutional/System Needs

The institutional or system needs identified are concerned ultimately with the requirements for effective implementation and institutionalization, but encompass all phases and aspects of the change process. These include planning, design, staff/participant preparation, management and operation, resource acquisition, and evaluation.

The various phases and aspects of a change process and the numerous factors that must be addressed by it are interrelated. They should be treated in a systemic way. Some of the factors to be addressed are based in the general characteristics of the system -- its internal policy, functions, structure, resources, and operations. Some are the result of the expectations, attitudes and priorities of the larger society in which the system operates (e.g. community, state, region). Others are directly related to the specific change or improvement sought.

Successful implementation of interdisciplinary environmental education will be dependent to a great extent on the appropriateness of the design process and the ability of participants in the process to use it effectively. Since design of specific interdisciplinary environmental education learning experiences and programs is perceived as a "local" initiative, the design participants would consist primarily of the individuals and groups upon whom successful implementation and institutionalization will depend. These include teachers, administrators, parents, students, and the range of public and private agencies, institutions and organizations in the community and region with relevant expertise and other resources needed.

In general, local experience in education program design has been limited. Local experience in the design of interdisciplinary programs has been even more limited. The design process should be organized and coordinated in a way that facilitates systemic treatment of the full range of substantive and institutional requirements, while increasing the knowledge and interdisciplinary design skills of its users.

More specifically, the design process should entail a division of labor for decision-making purposes as well as task performance. Determination, agreement on and the productive performance of the respective roles can be assisted through properly facilitated group inquiries in the substantive, structural and methodological aspects of the design process; individual study of the requirements and information needed to perform the roles assigned; and through coordination and technical assistance.

The process should incorporate approaches and methodologies that facilitate characterization of the various structural-functional levels of the system in which the program will operate, including the decision-making levels within and outside the system. It should enable conceptualization of the program as an interrelated set of activities that provide mutual support and systemic character which is reflected throughout the program design. It should assist the identification of appropriate contexts and the development of responsive program content. Finally, the process should assure that significant attention is given to the delivery system and support activities, including evaluation, that are required to make the design effective in practice and capable of meeting new needs as they evolve.

Evaluations conducted must also be appropriate for the program being addressed. Since programs are locally designed, the evaluations used for each site will be somewhat unique. However, there are some general needs and requirements regarding evaluation of interdisciplinary environmental education programs that apply to all sites and can be used as the framework for program-specific evaluation designs.

If they are to be useful, the evaluations must be based on a fully articulated understanding of the programs, including their specific designs and the generic requirements of the field as well as their actual operation. They should provide meaningful guidance for improving the substance and delivery of the programs' content and, if needed, the overall program designs.

Among other things, there would be an analysis of the degree of correlation between the generic substantive requirements of the field and the specific context selected by the program, its content, and the values and mission reflected by it. They would include observation and analysis of the systemic character of the program -- its comprehensiveness, coherence and compatibility with the larger system in which it operates -- as well as analysis of its major components. The analysis would take into consideration the design and operational decisions made, the rationale for them, and the changes in evidence as a result of their implementation.

These and similar factors, including the status of program implementation, provide the basis needed for development of criteria to assess relative strengths and weaknesses of the program and, if selectivity is required, to determine areas and/or aspects of the program to be assessed.

The approaches, methods and basic resources developed through the UVA project are designed for use by school, community, and "regional" groups that may or may not have had prior design experience. The project products address in some detail these and other requirements for interdisciplinary environmental education program design, and include both general and specific guidance for meeting them.

While the UVA project emphasizes the desirability of programs that are "regional" in scope (Regional Environmental Learning Systems or RELS), it was assumed that many of the program design efforts would be conducted initially on a smaller, more local scale. For this reason, the project recommendations and resources are directed to local and "regional" program design needs. Their general applicability for "regional" design was confirmed through pilot activities conducted through the Tennessee Valley Authority and the Pennsylvania State Department of Education.

Through another major project which is being conducted by the Far West Laboratory for Educational Research and Development (Far West), their utility for district-level formal education is being explored.

The Far West project began with the development of formal and community education personnel training models that use general systems themes and a general systems framework for the selection and organization of the content elements of environmental education. After developing and successfully piloting training materials developed from the models, Far West developed a generic model for institutionalizing environmental education in the formal sector. The model's design structure and process for identifying and considering design options were adapted from UVA's normative model of environmental education, and from one of several design processes recommended by it. Applications of the design methodologies and processes for school district/local programs are being piloted in the Bay Area (California).

The UVA and Far West projects were conceptualized, in part, from the results of earlier contract efforts. Both have made extensive use of the resources and information obtained through those efforts. Of particular note were the findings and recommendations obtained through a review of environmental education activities conducted by the Arizona State University and the Association of American Geographers in 1975. Failure to integrate meaningfully the broad range of content elements needed for understanding human/nature interrelationships was cited as the major, most widely noted obstacle to achievement of effective environmental education. The primary recommendation made was that core themes and a conceptual structure(s) be developed that can facilitate synthesis and integration of content elements derived from many different subject fields and disciplines. The Far West project's use of General Systems for its core theme and conceptual structure, and the UVA project models and processes for group-generated conceptual frameworks for design of learning systems or programs are extensions and elaborations of that original recommendation.

The resources developed through these and other projects funded through the Environmental Education Act program can contribute significantly to the achievement of interdisciplinary environmental education that is both effective and capable of being institutionalized. Collectively, they and other efforts in the field represent significant accomplishment in a task that is as demanding and complex as it is critical to our future well-being. An important aspect of our accomplishment is that we now have a basis for organized discourse and constructive collaboration in moving interdisciplinary environmental education into practice. All of us should take pride in what we have achieved and rededicate ourselves to the work that remains.

Walter J. Bogan, Jr.
Director, Office of
Environmental Education

DESIGNS FOR THE FUTURE OF ENVIRONMENTAL EDUCATION

PREFACE

How do you organize a subject as broad-ranging as environmental education? It is done with considerable difficulty. Yet without organization it is hard to find material, to relate materials to each other, and to establish perspective on the field. This Preface is intended to help you understand the organization of this report in relation to other work.

This report is organized in two Volumes. Volume 1 is the primary project outcome, while Volume 2 contains supporting draft material.

This report is the last in a series of reports developed through a project headquartered at the University of Virginia (UVA). This report draws on our own previous reports, as well as many other reports, some of which were mentioned in the Foreword. As you read this, you may find it useful to refer to an Appendix titled Abstracts of Reports. That Appendix describes many of the reports that furnish a foundation for this one, and tells how they may be obtained.

Chapter 1 of this report is a commissioned essay prepared by Dr. Philip C. Ritterbush, a man who has been involved for many years in interpreting science to the public. He was asked to review project materials and develop a document that gave his own overview of project results. While not intended to be comprehensive or bibliographic, this essay highlights project effort as seen by an outside observer. It may, therefore, be a good lead-in to the remainder of this report.

Chapter 2 is intended to focus on requirements for environmental education. This chapter gives the logic of environmental education. Requirements are described as primary, secondary, and additional. The chapter is summarized in a single drawing, called an "implication model" for environmental education. By tracing the logic on this drawing, as elaborated in the text, you may envisage the underlying concepts that reflect the basis for ensuing discussions.

Chapter 3 presents a series of models aimed at organizing environmental education as a topic of discussion, study, and implementation. Seven models treat separately educational values, a mission for environmental education, content of environmental education, design of learning systems, key decision areas in education, the decision structure in education, and the operating components of environmental education. These are tied together in an integrating model that shows how the other models relate to each other.

Chapter 4 is a summary presentation of how the resources for environmental education that were developed in the UVA Project and through the work of Far West Laboratory for Educational Research and Development connect to the various models. The results are summarized in a single drawing called an "index to environmental education resources." With this index, a reader is able to pinpoint resources that elaborate on the organizing models given in Chapter 3, as well as to the components of the operating model. Chapter 5 outlines an approach to evaluation.

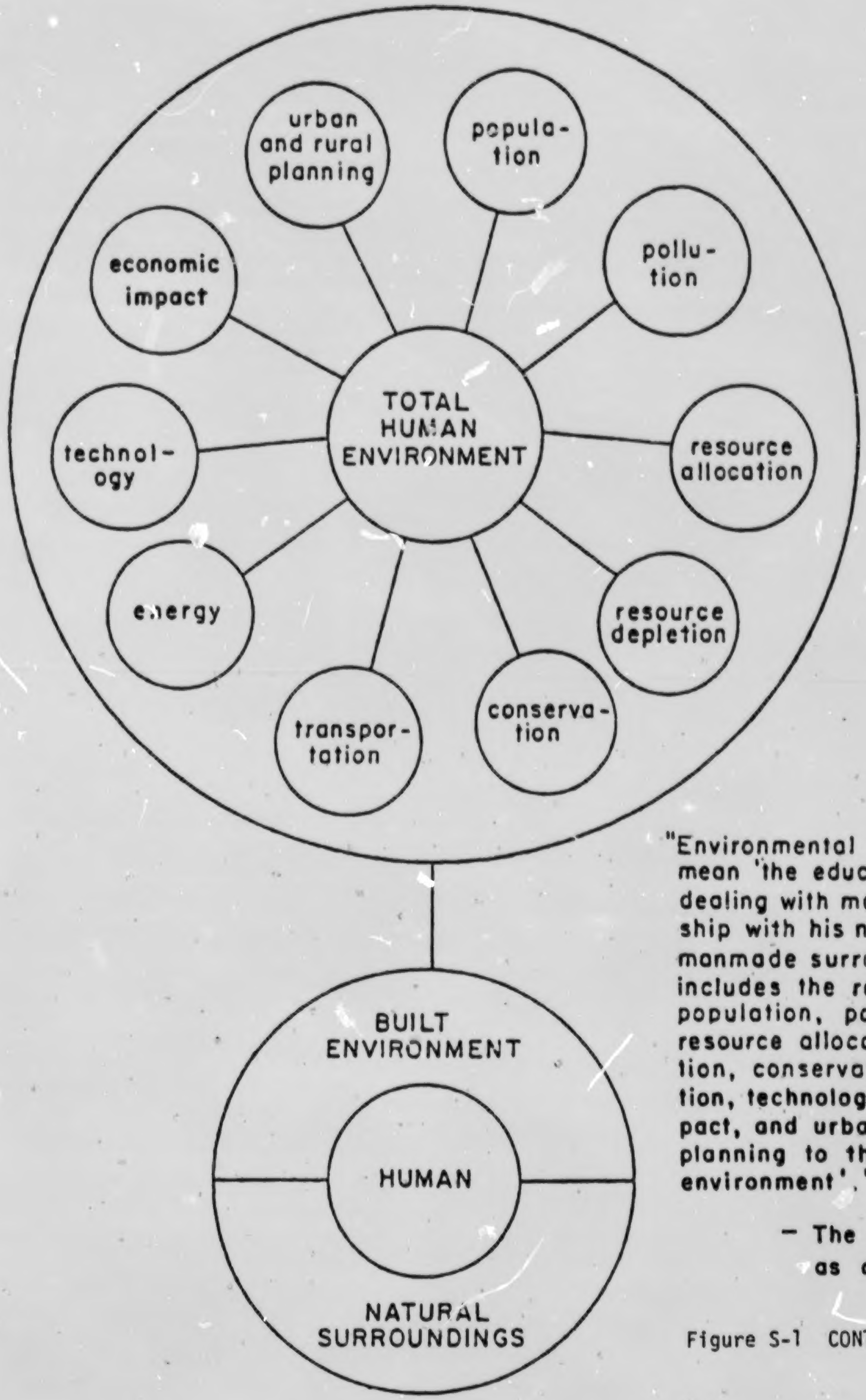
Chapter 6 summarizes the central recommendations of the project.

In the appendices, additional amplification is given concerning the material in the body of the report. Volume 2 is bound separately.

This volume contains a set of untested, draft self-paced learning units, and descriptions of additional units that could be prepared to make it easier to study environmental education on one's own schedule as time permits. Such a learning mode may be particularly valuable for readers who wish to learn at times when their schedule is relatively open. These materials can also be used as preparation for and as materials used in workshops on environmental education, as a basis for learning, discussion and decision making.

We turn next to a consideration of some of the primary organizing concepts found in this report.

The Environmental Education Act of 1970 (as amended) set forth a description of an educational innovation that the Congress perceived as greatly needed. Figure S-1 portrays environmental education as defined in the Act, both in a prose statement, and as graphically envisaged. The Congress emphasized the interdisciplinary nature of environmental education, and stressed that it should be a process involving the study of the relationships among the components represented in Figure S-1.


urban and rural planning
population
pollution
economic impact
TOTAL HUMAN ENVIRONMENT
technology
resource allocation
energy
resource depletion
transportation
conservation
BUILT ENVIRONMENT
HUMAN
NATURAL SURROUNDINGS

"Environmental education shall mean 'the educational process dealing with man's relationship with his natural and manmade surroundings, and includes the relation of population, pollution, energy, resource allocation and depletion, conservation, transportation, technology, economic impact, and urban and rural planning to the total human environment'."

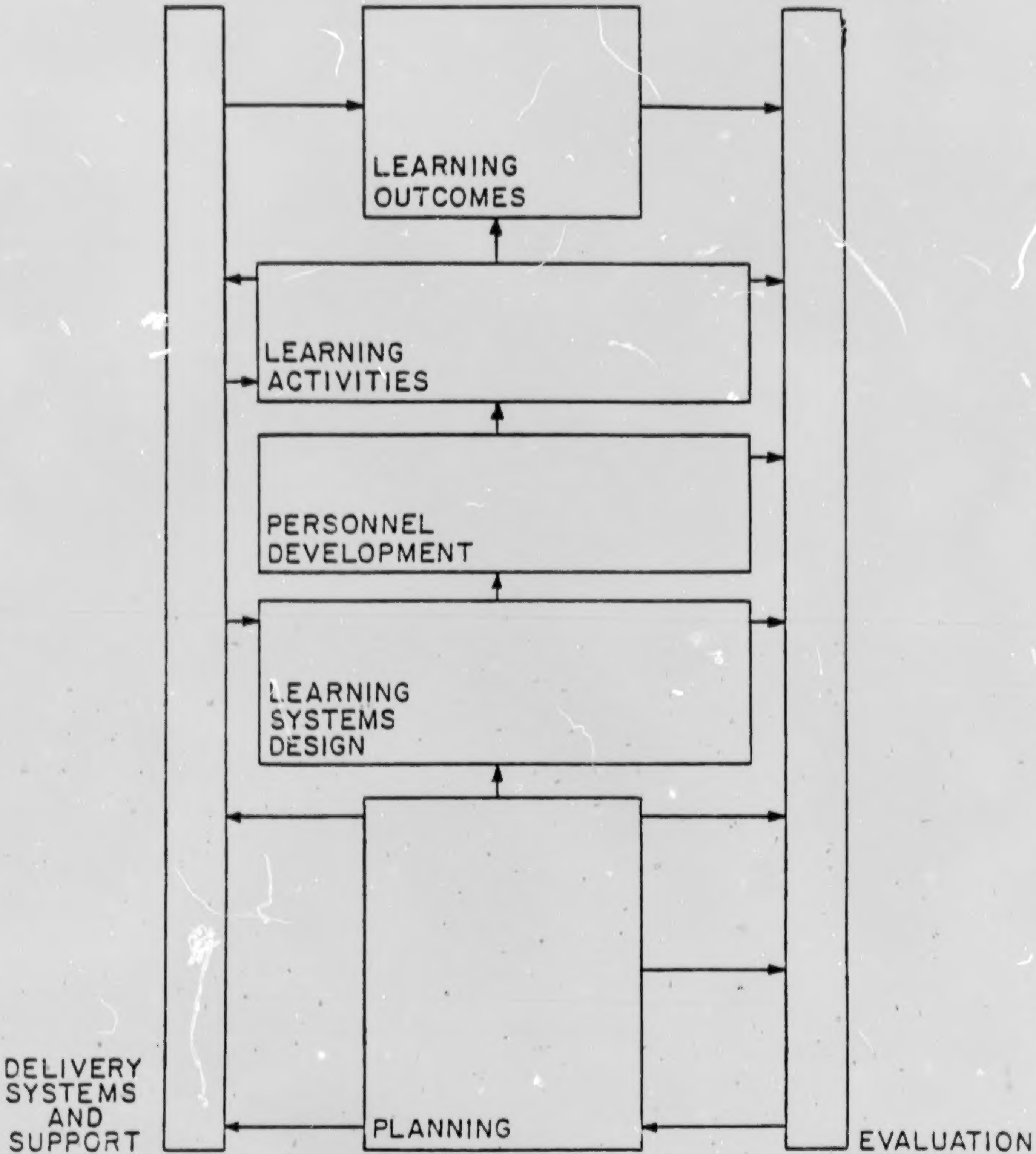
— The EE Act of 1970, as amended.

Figure S-1 CONTENT MODEL

Because interdisciplinary education is not well understood, only a few ideas stand out about it. One of these is the importance of working with relationships among somewhat disparate entities. Another is the complexity of working with such relationships. Finally there is evidence from numerous research studies that people require considerable assistance in working with complex relationships. For these reasons, facilitating processes assume considerable importance in environmental education, as in interdisciplinary education in general.

Those working in the various disciplines typically have evolved an understanding of what kinds of relations are important in their study. However, interdisciplinary fields in general, and environmental education in particular, require attention specifically to what kinds of relations will be studied in exploring the components of content. For this reason a special concern is needed for the types of relations that will become the focus of environmental education.

The management and operation of an environmental learning system requires a concept of an interrelated set of activities that provide mutual support and systemic character. Without these, environmental education proves to be fragmented, often ineffective, and very hard to evaluate in any constructive way. Thus the delineation of an organized set of activities, as illustrated in outline form only in Figure S-2, is a vital part of our concern.



LEARNING OUTCOMES
LEARNING ACTIVITIES
PERSONNEL DEVELOPMENT
LEARNING SYSTEMS DESIGN
PLANNING
DELIVERY SYSTEMS AND SUPPORT
EVALUATION

OPERATING MODEL Figure S-2

23

The arrow means "should help achieve".
The Learning Outcomes constitute the Mission Model.
Additional detail is available on the activities
from a reference report

In planning, implementing, and operating a system of environmental education, a division of labor is needed, both in terms of the work to be done and in terms of the decisions to be made. It is helpful to identify decision-making levels in the educational system, so that specific responsibilities can be attached which are appropriate to the various levels, and consonant with the mission and values of environmental education.

The values themselves are a critical basis for exploration. Figure S-3 shows a value structure that we propose for environmental education. This structure is extracted from the educational philosophy of Ralph Barton Perry, a professional philosopher and student of American education. These values, perceived in the light of detailed study of the requirements of environmental education, provide a judgmental base that can make environmental education credible as a part of American education.

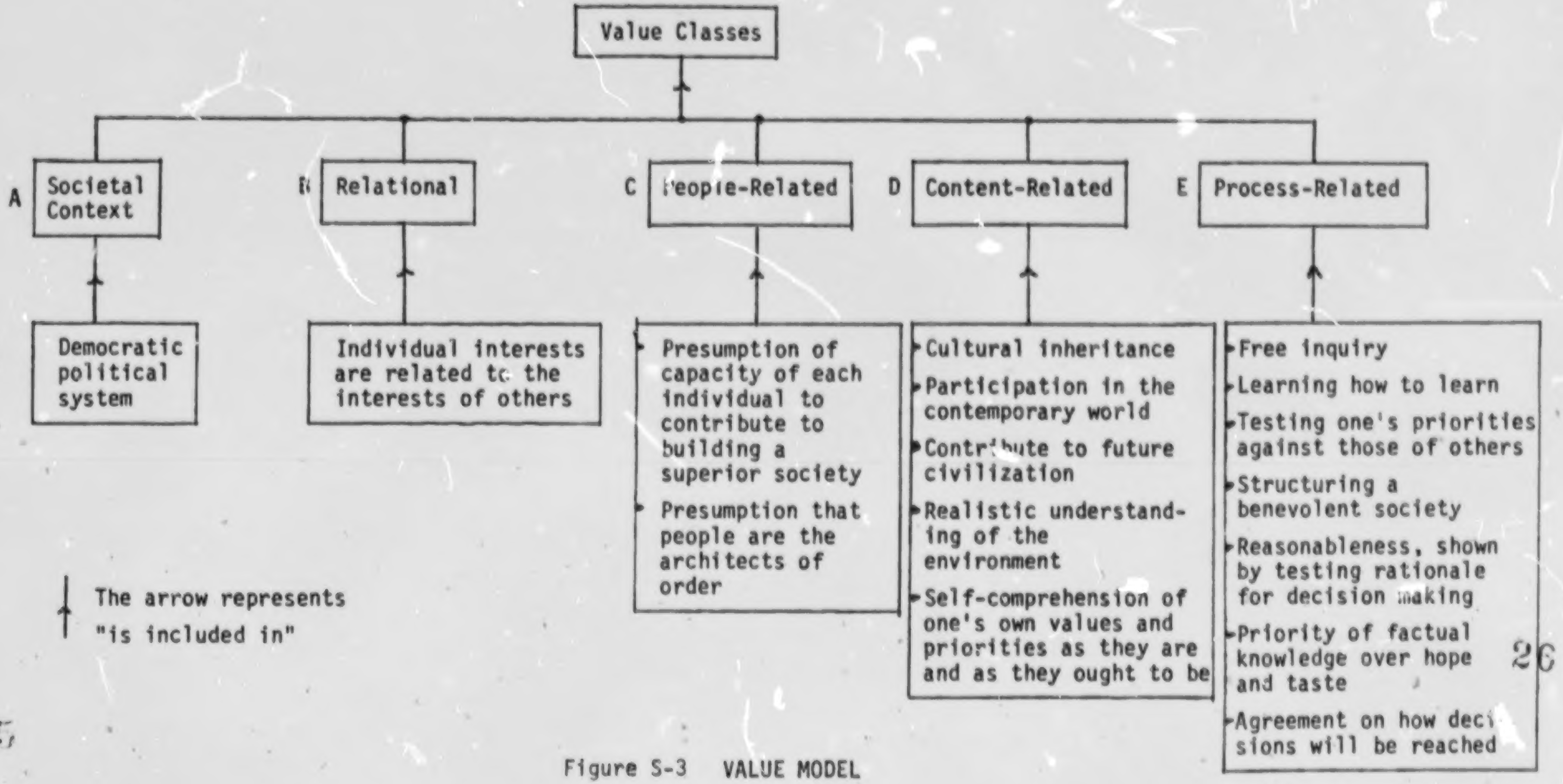
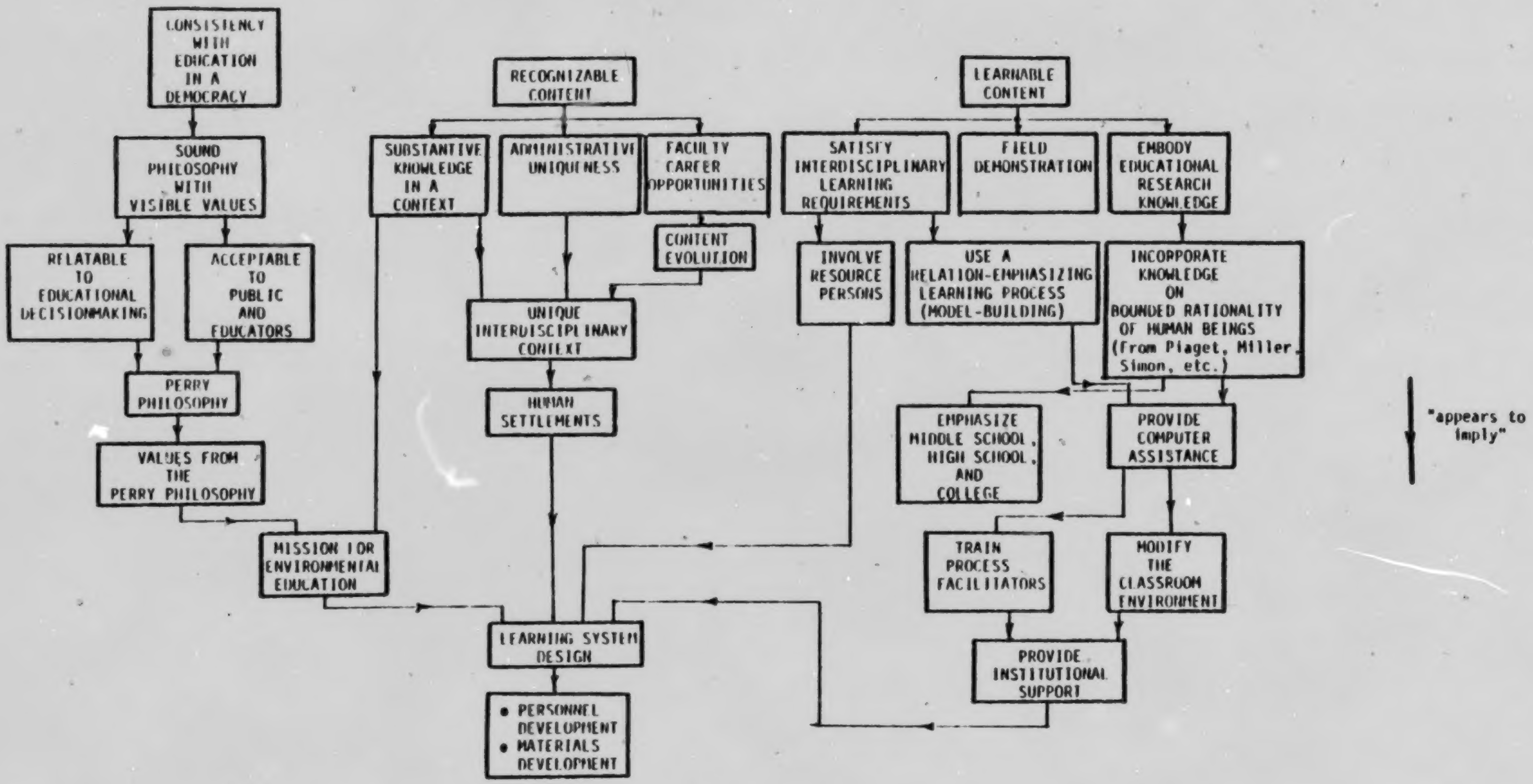

Value Classes
A
Societal Context
B
Relational
C
People-Related
D
Content-Related
E
Process-Related
Democratic political system
Individual interests are related to the interests of others
Presumption of capacity of each individual to contribute to building a superior society
Presumption that people are the architects of order
Cultural inheritance
Participation in the contemporary world
Contribute to future civilization
Realistic understanding of the environment
Self-comprehension of one's own values and priorities as they are and as they ought to be
Free inquiry
Learning how to learn
Testing one's priorities against those of others
Structuring a benevolent society
Reasonableness, shown by testing rationale for decision making
Priority of factual knowledge over hope and taste
Agreement on how decisions will be reached
The arrow represents "is included in"

Figure S-3 VALUE MODEL

The requirements themselves are envisaged as a connected set. Three primary requirements dominate our concern. These are:

- Establishing a philosophy and value basis for decision making with regard to environmental education
- Establishing a clear body of knowledge as the content of environmental education, distinguished by an appropriate context
- Establishing the learnability of the content in relation to various positions in the curriculum.

Figure S-4 shows how these primary requirements imply additional requirements. This implication model for environmental education, together with the normative model (see the Foreword and the Appendix titled Abstract of Reports), provide the basis for the organization, study, and implementation of environmental education.


CONSISTENCY WITH EDUCATION IN A DEMOCRACY
SOUND PHILOSOPHY WITH VISIBLE VALUES
RELATABLE TO EDUCATIONAL DECISIONMAKING
ACCEPTABLE TO PUBLIC AND EDUCATORS
PERRY PHILOSOPHY
VALUES FROM THE PERRY PHILOSOPHY
MISSION FOR ENVIRONMENTAL EDUCATION
RECOGNIZABLE CONTENT
SUBSTANTIVE KNOWLEDGE IN A CONTEXT
ADMINISTRATIVE UNIQUENESS
FACULTY CAREER OPPORTUNITIES
CONTENT EVOLUTION
UNIQUE INTERDISCIPLINARY CONTEXT
HUMAN SETTLEMENTS
LEARNING SYSTEM DESIGN
• PERSONNEL DEVELOPMENT
• MATERIALS DEVELOPMENT
LEARNABLE CONTENT
SATISFY INTERDISCIPLINARY LEARNING REQUIREMENTS
FIELD DEMONSTRATION
EMBODY EDUCATIONAL RESEARCH KNOWLEDGE
INVOLVE RESOURCE PERSONS
USE A RELATION-EMPHASIZING LEARNING PROCESS (MODEL-BUILDING)
INCORPORATE KNOWLEDGE ON BOUNDED RATIONALITY OF HUMAN BEINGS (From Piaget, Miller, Simon, etc.)
EMPHASIZE MIDDLE SCHOOL, HIGH SCHOOL, AND COLLEGE
PROVIDE COMPUTER ASSISTANCE
TRAIN PROCESS FACILITATORS
MODIFY THE CLASSROOM ENVIRONMENT
PROVIDE INSTITUTIONAL SUPPORT
"appears to imply"

IMPLICATION MODEL FOR ENVIRONMENTAL EDUCATION

Figure S-4

Chapter 1

MOVING AHEAD IN ENVIRONMENTAL EDUCATION

by

Dr. Philip C. Ritterbush

ENVIRONMENTAL EDUCATION IN CONTEXT: UNDERSTANDING THE SYSTEMS ECOLOGY OF INDUSTRIAL SOCIETY

In the recent affairs of the nation, environment appears as a ground over which opinions divide. Concern for the natural environment seems opposed to the economic imperatives of industrial society. Environmental protection has been criticized as an unwelcome complication of economic development, on grounds that it adds years to the time required to complete public works and imposes burdens of regulation on business that threaten our competitiveness in world markets. On the other hand, economic development activities have been criticized as harmful to the environment. This dichotomy, however, has been observed by many to be a false one. The principles that govern nature--the ecology of nature--also define, to a significant degree, the nature of human society and its options for achieving a state of well-being, for successfully performing its economic functions. The ecosystem is the economy of nature. The economy is the ecosystem of human civilization. The two are inextricably intertwined.

Environmental education aims to improve our understanding of the natural and social support systems as an interactive, interdependent whole. Systems as a whole tend to be invisible to the people they serve and therefore rarely make news. Similarly, the normal functions of interaction between the natural and social support systems or between their respective subsystems tend to be invisible. But it is the normal functions of these interactions--meeting demand, increasing efficiency, maintaining and improving quality, planning or investing for the future--that are the central concern of environmental education.

Understanding the options, constraints, opportunities, and costs related to the use and functions of these systems will be needed if we are to increase in the future our ability to resolve the issues that emerge from our need for effectively functioning social and natural support systems. It is not a question of "either, or." Both must be maintained if humankind is to survive. Environmental education attempts to provide these understandings.

The sentimental vein of nature appreciation is entitled to respect as part of our national heritage, but this cannot take the place of knowledge of the interactions between nature and human society. Conversely, those who have been accustomed to regard concern for ecological balance or protection of the natural support system as somehow inimical to economic development, for example, overlook the fundamental interdependence between them. The first scientist to derive a vision of "a vast interstate and foreign commerce" for the United States from an accurate assessment of its natural resources was a Harvard University economic geologist, Nathaniel Shaler. In his remarkable treatise, Man and Nature in America (1897), he wrote that an understanding of the environment must guide the design of economic growth. "With the growth of each of these elements of civilization; the arts of the household, of war, and of trade, the chains which bind man to the earth become even stronger. It is impossible to depict in an adequate way the dependence of our modern civilized man upon the world about him."

Difficult or not, students are beginning to learn about the interdependencies and interactions between human society and its natural support system. On the day you read this it is likely that a school group has visited the power plant that lights your room. Their visit is part of a course on the economic, health, and natural resource costs and benefits of direct and indirect uses of energy in food production. Among other things, they are tracing the energy inputs from fossil fuels in this process and have learned that even the electric power used by your community is derived from fossil fuels.

The laws of the science of energy apply with equal force to living metabolism, to work in all its forms, to engines and their fuels, to lakes and meadows, to insect colonies and electric power systems. In many schools students are comparing the energy content of fertilizers, foodstuffs, forest industry byproducts, human wastes, fossil fuels, and alternative power sources in process budgets for agriculture, manufacturing and transportation. Homework exercises involve youngsters in calculating the fuel savings from domestic insulation, industrial cogeneration of power, and automotive innovations. These youngsters are beginning to think about energy systems in terms of operating efficiencies, fuel requirements, and external environmental impacts.

It is the natural community of organisms sustained in any given stream that enables it to purify human wastes. A good number of tomorrow's citizens have counted the densities of these organisms in nearby streams, projected future community population growth based on hypothetical economic development plans for the area, and are learning how to assess the probable impacts of population growth on the waste treatment facility.

Student "representatives" of consumer groups, regulatory bodies, banks, and legislators are earnestly discussing the future shape of the economic infrastructure of their region. Others are developing alternative transportation plans for their city and are identifying the possible impacts of the plans on the air and water quality, land use patterns, and health, economic, and social needs of the city.

Activities such as these have been found to be among the undertakings of projects funded through the federal Office of Environmental Education in a study conducted by a consortium under a contract with the University of Virginia. In these projects, students are beginning to study, as interrelated wholes, processes that generally are perceived and treated in a fragmented way.

The purpose of such environmental education is not to second-guess the decisions being taken by the community now, but to foster a balanced awareness of factors constituting a network of interactions among humans, their social systems, and the total physical and biological environment so that future decisions may be more wisely appraised and more soundly executed.

While much remains to be done to improve student learning opportunities in environmental education and to better assist teachers who strive to engender this "holistic" understanding, progress is being made.

In the classroom an energy facility proposal is likely to be regarded in a regional context where benefits and risks can be expressed in comparable terms so that views do not become too strongly opposed to be reconciled. Innovative methods for studying and resolving issues can be practiced in the classroom, for later transfer into the informal education sector and into public settings.

The regional awareness that permits the integration of watersheds and transportation networks into a conceptual framework for thought also serves as a ground for the comparison of health risks with development gains so as to engender an awareness that natural resources and social facilities are complementary features in encompassing patterns.

The art of understanding human settlements traces relations among support systems or networks, the built environment of "shells" for social activities and shelter, social performance, human satisfactions, and the natural environment.

Someday it may become necessary to replace the waste treatment plant in these students' community, to consider expansion of their local utility's power generation capability, or to develop a new economic development plan for their region. The process of obtaining public approval will be less likely to take the form of a pitched battle. It is likely instead that alternative proposals will be reviewed thoughtfully in a public manner. Instead of being divided by issues, the community will be more likely to achieve a consensus in favor of an approach or method that is most responsive to the needs and constraints of both the social and natural support systems of the community and region.

Ground divided by the issues of today is being sown with seeds of awareness and knowledge to yield a harvest of understanding for citizenship tomorrow.

SETTING THE AIMS OF ENVIRONMENTAL EDUCATION

In 1970 Congress enacted the Environmental Education Act out of a recognition that democratic political institutions could not function properly unless society's relations with the environment were more widely and fully understood. The Act defines environmental education as "the educational process dealing with man's relationship with his natural and man-made surroundings, and includes the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, economic impact, and urban and rural planning to the total human environment." It authorized a program of grant and contract support for curricula "in the preservation and enhancement of environmental equality and ecological balance." Support was to be provided for programs in elementary and secondary schools.

Teacher training and other means of professional development were to be made available to government employees, and business, labor and industrial leaders and employees. Outdoor ecological study centers were to be planned and materials suitable for broadcast use in the mass media were to be developed, as were "community education programs on environmental quality, including special programs for adults."

Appropriations for the first full fiscal year were authorized at $5 million, and $15 and $25 million, respectively, for the years following.

Two Congressional aides who participated in the passage of the legislation later wrote a book about the Act in which they characterized the approach the authors of the bill hoped would eventuate in the schools.

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"That process was action-oriented and it envisioned increasing environmental awareness and providing the skills, knowledge, and motivation required to solve environmental problems."*

Four years after passage of the Act, a team of reviewers from the Arizona State University criticized environmental education, in practice, as being too narrow in approach and orientation. They found that there had been a "failure at all levels of education to achieve a truly integrative treatment of the relationships between man and his natural and manmade surroundings."**

The principal recommendation of the study was "to develop core themes and a conceptual structure in environmental education that synthesizes and integrates pertinent subject matter across and between a variety of traditional disciplines." This study recognized the difficulty of realizing the aims of the Environmental Education Act in an educational system built around individual subjects individually taught in individual classrooms. As work under the Act continued in succeeding years, more effective approaches might emerge from experience gained at the community level. The difficulties of pursuing the Act's encompassing aims through normal operating structures of education were also apparent in administration at the federal level, where $3.5 million remained the maximum available for the direct purposes of the Act in any fiscal year.

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* D. W. Brezina and A. Overmyer, Congress in Action: The Environmental Education Act, Free Press, New York, 1974.

** "Environment-Based Environmental Education: Inventory, Analysis, and Recommendations," Final Report on Contract No. OEC-74-8739, 30 June, 1975.

Looking toward the tenth anniversary of the legislation, the Office of Environmental Education provided for another review. An Environmental Education Project was established in the Research Laboratories for the Engineering Sciences at the University of Virginia. The curricula and programs funded by the Office were reviewed. Digests were prepared to improve access to these materials by educators.*

The purpose of the UVA project was not competitive evaluation of hundreds of classroom and community efforts. This would have necessitated comparison of many different kinds of environmental and educational situations across an entire nation. Instead the UVA consortium sought to distill from this wide-ranging educational experience a set of goals and a set of designs for processes whereby the goals could be met.

Their study aimed to determine what kinds of processes will best enable a complex industrial society to prepare its citizens to participate in an informed and responsible way in the resolution of the environmental issues of today, and to contribute to an improved quality of life in the future.

When the Environmental Education Act was proposed, several educational officials pointed out that the schools were already treating many aspects of the human environment in social studies and natural science classes. Without question, most of the information which students acquire about the natural and the man-made environment must come through instruction on the pattern that now prevails in the nation's schools, as must their basic skills in learning.

But the premise of the Environmental Education Act was that the choices facing our society required a new dimension in citizenship, going beyond the normal terms of political debate. The environment, as some civic leaders were rather ahead of many educators in perceiving, posed choices not merely about what actions citizens should expect of government, whether local or national, but how they could participate more knowledgeably and responsibly in the illumination of issues and in the choice of options. How could they become more knowledgeable about energy systems and the relative costs and benefits of their development and use? How could they acquire an image of the human settlement pattern as a connected whole, and its implications for the social and natural support systems? How could they fulfill individual responsibilities of trusteeship for future generations?

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* See the Appendix for a summary of the reports from this project.

Community representatives who participated in environmental education projects have indicated that issues concerning them could not be properly understood unless students could learn, in the schools, methods whereby choices confronting the society could be examined systematically and brought to the point of informed decision.

The program authorized by the Act was one of innovation in the scope of instruction, functional linkage between ecological and social analysis, and experiments with curricular approaches encompassing the full range of environmental relationships. The fact that proposals for such undertakings have been funded and successfully implemented in school systems and communities can be cited as proof that the approach which the Act sought to encourage is one that has been found acceptable to educational as well as civic interests throughout the country.

The UVA study provided considerable definition of environmental education in a way that lends itself to assessment of local and regional progress.

Four characteristics of success were identified. The first is awareness of the manifold environmental factors that make the human relationship with the environment one of mutual dependence for health and well being. The second is the ability to seek and attain a balance among the social, economic, and biological elements of human environmental interactions. The third is knowledge of the environment as related to social, technical, and natural systems in normal function and when perturbed. The fourth characteristic recognized in the study is enhancement of decision-making as it relates to important issues affecting the future of the society.

The Environmental Education Act has been interpreted as affording support so that the nation's schools can enhance these four characteristics. The UVA study encourages school systems to assess their present performance on the basis of these. The specific terms of environmental policy and social need that constitute local and regional goals will figure in any such assessments. Educational programs already fulfilling these aims are only of general interest to the Office of Environmental Education, as it is not primarily a review body. Where gains in the performance of social support systems remain to be realized through learning about human settlements and technology in the environmental setting in which they function, the Federal Government should continue to provide resources to do that job and place them at the disposal of communities and their schools. The eventual result, recommended in one of the UVA study reports, should be "the broad and complete institutionalization of environmental education throughout the nation."

The UVA study recommends a process for the development of environmental education programs to enlist diverse elements of an educational system in the community setting. This would include elements from the formal and the informal education sectors. A series of steps was envisioned that could be regarded as a model for cumulative changes in the educational enterprise. It was advocated that different sites and units of instruction be recognized as elements of a "learning system design" which can gradually be refined, either in practice or through periodic review. Local initiative is stressed as the primary key to success.

The design should accomplish an infusion of ideas and methods into education so that social and individual learning result and effects can be measured through better decisions in society's interest. Activities at field study centers or other learning sites can be assessed for the part they play in the design, and future plans for the region should enter the formal education process as elements to be explored. The design should present options for the development of environmental education activities in terms of an options profile (described in detail in one of the project reports), in which choices about future directions become clearly visible to educators and civic interests.

A central accomplishment of the UVA study was to articulate a structural model for environmental education with seven "cells" into which desired learning outcomes and all specified activities carried out under the Act could be entered. While these activities serve individually to train teachers or result in understanding of human-environment interactions, they reflect, collectively, progress within the school system, community, or region, toward capabilities desired for environmental education on a continuing basis.

A central difficulty in meeting the aims of environmental education has been that the context in which benefits of awareness and understanding are sought is at least as large as the social, economic, and ecological future of a region. Few projects have been fully regional in scope, and these tended to be more oriented toward the present than to the future. The majority of past projects reviewed focused on matters related to single issues as manifested in a single locale, a small part of a geographic entirety. Many educators rightly insist on treating those local or functional aspects that students can see at first hand, or about which they are best prepared to learn in the classroom. In order to be as educationally effective as they can be in the present, teachers and auxiliary persons disengage from the holistic and regional dimensions needed for optimal goal achievement.

The UVA study, in its descriptive analysis of environmental education, made visible the difficulty just cited. How could teachers working in particular subjects or community representatives concerned with some one issue enlarge the educational scope, while continuing to provide effective educational services?

FULFILLING THE AIMS OF ENVIRONMENTAL EDUCATION

The need to link individual units of instruction or a single issue with a more embracing context closely resembles a difficulty common in all design practice. The functions of individual components must be improved step by step, while overall performance can be measured only in system terms.

The UVA study suggested that approaches to overcoming this difficulty that have been found useful in design practice hold promise in developing learning systems. Institutions that have pioneered in methods for "collective inquiry" that are widely used in other settings were asked to apply such methods to environmental education.

One method that enables people to establish how parts of complex systems are related is called "interpretive structural modeling (ISM)." Innovative methods of idea generation are applied to list as many individual elements as those involved can identify. Following discussion to clarify, to eliminate duplication, and to gain general understanding of the elements, the next step is to consider and select some well-defined relation as it may apply to all possible pairs of items listed. The relation chosen might be "is a partial cause of," so that participants could vote in the exercise according to how they perceive various events to be causally related.

A subject that was considered in this way in one of the project reports was the use of land in the vicinity of urban centers. By subjecting each feature of the issue to a process of assessment in which each person votes after discussion of the relationship involving a given pair of elements, a structure gradually emerges to reflect judgments in the aggregate derived from different special outlooks, such as food production, development concerns, topsoil runoff, and population pressures.

"In the process of deciding whether the relation holds between two elements, the group often develops an improved definition or understanding of the elements or the relation," comments the report on collective inquiry methods. "They also gain a better understanding of other participants' views about the elements or the values, beliefs, or perceptions of other participants. These improved understandings are among the main beneficial outcomes of collective inquiries."

Another procedure, called the "nominal group technique (NGT)," is useful in eliciting individual written answers to questions about specific components. It relies on facilitated discussion to identify interrelationships, followed by anonymous voting to achieve shared judgment.

One of the collective inquiry techniques reviewed for its utility in environmental education was the "charrette," a group design procedure often used in architecture. The study discussed a charrette employed to plan land use in the Shawnee National Forest in Illinois. In Columbus, Ohio, the Battelle Memorial Institute and A. T. and T. collaborated in an assessment of community expectations for the public school curriculum that involved 1,700 people. The study also commissioned a trial of a variety of the collective inquiry methods on a range of environmental issues within the Tennessee Valley Authority region, and evaluation disclosed that they were highly rated for contributing to solutions of concrete problems in planning and decision making.

"Learning about one's environment encompasses a large number of factors," the study reported. "Understanding all these factors, their interrelations, and their implications for managing the future cannot be done alone. Involvement in collective inquiries with other participants with a variety of skills, knowledge, experiences, perceptions and values is required."

A belief that technology and environmental quality are at odds with each other has contributed to the impression that environmental issues remain impossible to resolve. The educational counterpart to this impression is that while the schools can teach the appreciation of nature or can confer an understanding of the complexities of our industrial society, they cannot integrate the two forms of knowledge.

The University of Dayton, the University of Illinois, the University of Northern Iowa, Vanderbilt University, as well as the Far West Laboratory for Educational Research and Development and other collaborators with the University of Virginia in the environmental education study have demonstrated that collective inquiry methods may serve communities in formulating designs for environmental education. Where the separate emphases of fields of study have tended to fragment the educational enterprise, the interrelationships throughout the human-environment complex may exert an integrating influence in discussions among community representatives, environmental groups, industrialists, and educators.

The principal process recommendation of the study is that collective inquiry methods be instituted at the community level. Where communities and school systems have been impeded by differences in outlook and approach among different educational fields or differences among the professional functions of segments of the community, group processes using the collective inquiry methods are recommended as powerful learning means, helping to maintain progress toward better integrated programs in the future.

The overall conception of environmental education provides for a system perspective. There are seven cells in the structure. (1) Planning is accompanied by the development of (2) delivery systems and support. Both contribute to (3) learning system design. (4) Personnel development may be necessary as a preliminary to (5) the learning activities that occur, leading to (6) learning outcomes. All feed into the judgmental process of (7) evaluation, which also feeds back into (1) planning.

A regional framework can be chosen because it is the focus for decision, because most social support systems are regional in scope, or because ecologists and geographers are accustomed to analyze interactions on a regional basis. "A 'region', in our design concept," comments one of the study reports, "is defined as the largest territory of common concern of a functioning pattern of human settlements which has the greatest opportunity to match problems and potentials with resources--whether or not there is presently a unified regional government. A regional perspective strengthens the opportunity to consider the long-range impacts of current actions; match the scale of the decision process to the scale of the problems; create integrated solutions to problems such as transportation, housing, water, waste disposal, energy, and land use; consider the social and economic impacts of changing the physical environment; provide for feedback from citizens to other policymakers; and to make appropriate use of science and technology."

Given that the major natural geographic regions of the country are ecologically distinct, by virtue of climatic and resource differences, they can serve as frames of reference within which to develop the model recommended in the study. One of the benefits of doing so would be ready transferability of instructional resources within each region, where agriculture, aquatic and marine biology, land use and water quality, and other matters affected by climate are fairly uniform.

Since many environmental issues are resolved by assigning different weights to variables, solutions might be general within any one region. Participants in the study looked upon regions as helpful contexts for evaluations of educational accomplishment. The Office of Environmental

Education could support the development of instructional materials suitable for use within each region by encouraging proposals from school systems, universities, community groups, and professional organizations. Adoption and use of the materials elsewhere in the region would remain subject to local option. Regional resource centers and regional meetings would afford opportunities to share and assess mutual interests and achievements.

The recommendations in favor of regional environmental learning systems reflect a judgment that widely used design procedures make it feasible to develop programs in this way. One of the most significant aspects of the procedures recommended is their readiness for implementation. Workability and effectiveness of the approaches are emphasized. Underlying every workable design is a body of compatible knowledge brought to the design by the participants, through the local initiative process. "It is clear that design has not been a significant concern in educational research and development," the study observes. Using best available knowledge, and building upon the realities of present systems are standard practices in professional approaches to design which many efforts to introduce innovations into education have disregarded. So is follow-up, "for infusing the design in a region and ... for evaluating the design once it is in place."

Considerable effort is given to the description of graphics to convey understanding of complex system processes without extensive verbal descriptions. Throughout the study imagery was sought that might communicate effectively with community leaders and educational administrators. Communities that do not have their own "map" for environmental education might well diagram their present efforts according to the seven-cell model and decide which areas need to be emphasized more in the future. Collective inquiry methods can serve to translate discourse among educators and civic leaders into designs for regional environmental learning systems.

The Office of Environmental Education has served as a source of support for extensive resource development and trials of instructional programs encompassing the full range of human-environment interactions. A shift toward regional objectives requiring several years to plan, to develop personnel, to design learning systems, and to create delivery and support systems would require change in the pattern for the administration of support. The study served to encourage consideration of more comprehensive, multi-year projects by the Office and also levels of funding closer to the full authorization set by the Act.

Overcoming the shortcomings that remain in environmental education will require us to surmount a number of institutional and conceptual hurdles.* The study suggests that environmental education could enter a new phase of fruitful service and constructive accomplishment. The best index of the need to continue in this direction is to be found in the number of environmental issues that will perplex men and women in America until we have learned how to resolve them.

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* "The Institutionalization of Environmental Education in the Formal Education Sector: A Generic Model," Product from Grant No. G007802598, September 1979. Far West Laboratory for Educational Research and Development, San Francisco, CA.

Chapter 2

REQUIREMENTS FOR ENVIRONMENTAL EDUCATION

INTRODUCTION

Environmental education *can* be developed, understood, and institutionalized. It *can* become a major factor in bringing about greater harmony among people and their surroundings. It *can* give the individual increased power to make good decisions concerning life patterns, careers, and the improvement of society.

But what *must* be done *before* these possibilities can become realities? This is the question we explore in this chapter.

PRIMARY REQUIREMENTS

Environmental education is an innovation. Every innovation develops in stages [1]. Support for and allegiance to an innovation is small at first. Until certain primary requirements are satisfied, the innovation generally will not go beyond the initiation stage. After the primary requirements are satisfied, the innovation may enjoy substantially increased support and legitimacy. What are the primary requirements for environmental education in the United States?

There are three primary requirements that environmental education must satisfy before it can progress beyond the initiation stage of its evolution. They are:

A. Environmental education must be conceived so as to be *consistent* with education in a democracy.

B. Environmental education must be understood as being associated with a recognizable body of knowledge, i.e., a content, that lends substance and uniqueness to it.

C. The content of environmental education must be shown to be learnable in distributed positions throughout the curriculum.

Consistency is needed so that environmental education can gain the popular support that is needed to finance it, and the understanding that is needed to administer it. It would also be very helpful in making environmental education more competitive for time in the curriculum.

A content is needed to give professional credibility, so that its educational practitioners are not handicapped in comparison with others who enjoy the status of being associated with a recognizable body of knowledge. Unless a content can be clearly identified, the necessary personnel cannot be developed in the numbers required. People cannot identify and pursue career paths that are vital to educational program planning. Without a significant cadre of professionals in the field, linked by a commonality of content interests, the evolutionary development of content in form suitable for students cannot be achieved.

Value consistency and identifiable content are not sufficient unless it can also be established that the content is learnable, and specifically that it is learnable in recognizable patterns embedded in a temporal pattern within the curriculum. If the content is learnable, and can be properly positioned in the curriculum, there is an opportunity to move ahead.

Even if the three primary requirements are satisfied, there is no guarantee that environmental education can be successful. The primary requirements imply further requirements.

SECONDARY REQUIREMENTS

Let us now approach the primary requirements in more detail, for the purpose of discovering those secondary requirements which literally radiate from the primary requirements.

As we contemplate the primary requirements, we keep in mind the likelihood that environmental education will be judged by standards that go beyond those that apply to many other subjects. Environmental education relates strongly to matters that are of vital interest to almost everyone. Moreover environmental education is interdisciplinary, cutting across established educational "turf." Requirements that might be irrelevant or weakly relevant in assessing other educational areas may loom large in assessing environmental education.

A. Establishing consistency with education in a democracy.

How do you establish that environmental education is consistent with education in a democracy? The environment makes headlines. There are demonstrations, incidents, advocates, petitions, highly emotional public meetings, and controversies. Environmental problems are high in public consciousness. When you hear the word "environment" these days, it probably does not invoke images of Mr. Chips teaching his class.

We feel that, to establish consistency with education in a democracy, the following requirements need to be met:

A-1. A sound philosophy must be discovered, articulated, discussed, accepted, and used as a basis for making the major decisions that are required to propel environmental education. The values embedded in the philosophy must be given high visibility and loyalty in order to lend focus, coherence, and credibility to environmental education.

A-2. Educational leaders and the general public must find this philosophy compatible with their views on how environmental education should be envisaged, and on how it should evolve.

A-3. The philosophy must be relatable to and figure prominently in operational decision making in such matters as personnel development and curriculum design.

These are three secondary requirements related to "consistency" that seem to be naturally imposed on environmental education if it is to advance from its initial stage.

B. Association of environmental education with content.

It is generally recognized that environmental education is inherently interdisciplinary. This clearly means that it must draw upon established disciplines for some of its content.

Educational institutions are organized around disciplines, and this kind of organization is what makes possible the administration of the institutions. Otherwise there would be chaos in such matters as assigning responsibility and measuring performance.

If environmental education (or any other interdisciplinary subject) is to achieve an established niche in the organizational structure of educational institutions, a way must be found to distinguish it sharply from the disciplines. It is content that distinguishes the disciplines. But because the content of environmental education overlaps that of the disciplines substantially, it is harder to distinguish environmental education by content alone.

However an interdisciplinary field is distinguished, it must provide clear career opportunities and directions for scholars, not only in teaching but also in research. Otherwise there is no path to content evolution, and without the latter the field stagnates.

We conclude that there is a secondary requirement associated with content:

> B-1. A very clear context is needed for environmental education that will distinguish it sharply from the disciplines, facilitate administration, identify career opportunities for scholars, and point the way to evolutionary development of content.

C. Establishing learnability and positioning in the curriculum.

The Environmental Education Act (as amended) identifies these components of content: natural surroundings, the built environment, population, pollution, energy, resource allocation and depletion, conservation, transportation, technology, economic impact, and urban and rural planning. In defining environmental education, the Act emphasizes that it shall be a process that emphasizes the relationships among these components. The interdisciplinary nature of environmental education is amply represented in this description.

How does one demonstrate learnability and how does one assess the position in the curriculum where learnability can be expected to be demonstrated? Here are some potential sources of assistance:

- Experience in learning interdisciplinary subjects
- Field demonstrations
- Research knowledge concerning human learning capability at various stages in human development

Unfortunately there is relatively little documented knowledge about learning interdisciplinary subjects coming from experience with such learning. Anecdotal experience is not of much help, though it might become of more help in the future if such experience can be gained.

While field demonstrations are proof of the pudding, there have been very few of these in educational settings, in relation to environmental education as described in the first paragraph of this section.

In the initial stage of environmental education, we are forced to rely on a rather extensive amount of research evidence concerning human learning capability. While this research knowledge is somewhat controversial (and will probably continue to be for many years), there is a considerable amount of research evidence to show that insofar as learning relationships among a set of elements, these conditions apply:

- People are generally not very capable of working mentally with more than five or six concepts at a time [2]. This is because of inherent physical limitations on "short term memory," as opposed to "long term memory" which retains accumulated knowledge. It is only after people have been able to explore more or less systematically the relations among several concepts that they can reconceptualize that learning so that what once appeared as multiple, unconnected concepts takes on the appearance of a single concept. This description of how knowledge is accumulated and organized is called "chunking" in the literature [3].

- Skill at chunking begins to be manifested around the age of 12 [4].

There is also a substantial amount of field evidence to show that the capacity of people to work with many more than five or six concepts can be greatly enhanced if a computer is used to assist them in keeping track of and organizing the relationships that are being studied [5].

We conclude that the secondary requirements associated with the primary requirement of learnability include

C-1. A computer-assisted learning process is required to overcome demonstrated weakness of the human being to work with relationships among a set of elements such as the components of environmental education (and the components of the components).

Furthermore, in relation to curriculum positioning, we conclude that

C-2. Environmental education, insofar as it involves the efficient learning of relationships among environmental components, is much more likely to be effective for students beyond the elementary education levels.

In grades K-6 awareness and background may be developed. But primary energies in personnel development and curriculum positioning should be given to middle school, high school, and college programs.

ADDITIONAL REQUIREMENTS

Let us now hypothesize that all of the primary and secondary requirements have been met. By way of review, here is what would have been accomplished:

There would be widespread agreement on an educational philosophy that incorporates appropriate values whereby environmental education is clearly reconciled with education in a democracy. These values would be seen as providing a fundamental basis for governing the development of environmental education. Leadership and the public would find this philosophy compatible with their views on how environmental education should evolve. The values would have been learned and appreciated at the operating levels in the educational system, and would be applied in carrying out personnel development and curriculum design.

A clear context would have been established for environmental education that distinguishes it sharply from the disciplines, identifies career opportunities for scholars, and points the way to evolutionary development of content.

A computer-assisted process for learning relationships among components of environmental education with inputs from the disciplines would be in use, as required, in learning the content of environmental education. Appropriate positioning of content in the curriculum would be known.

Under the hypothesis that all of this has been accomplished, what other requirements might be envisaged for the evolution of environmental education?

Certainly an additional requirement would be

D-1. Personnel development efforts would be required to familiarize a cadre of persons with the knowledge that is inherent in fulfilling the primary and secondary requirements.

This would be needed so that the means of fulfilling the primary and secondary requirements would not be limited to a small group of people who had become familiar with the requirements through vicarious means.

Another requirement would be to develop the educational materials needed to provide the content background against which the relationships among environmental components can be assessed. More specifically,

D-2. High-quality content resource material would be needed that deals with the components of environmental education listed earlier.

[In the short run, an effective strategy can be to use materials resources developed specifically for environmental education such as the energy training materials developed by Far West Lab and the human settlements materials developed by UVA (see Appendix 3), along with regional planning materials such as those presently available in draft form for the Rocky Mountain Region [6] and for the State of Utah [7], the latter dealing with planning for wise use of forestry and grassland resources.]

Still other requirements are as follows:

D-3. Reconceptualize the role of the teacher. A teacher should not be expected to know all of the relationships that are being dealt with among the components of the changing environment. The teacher's role shifts rather dramatically. The teacher is still responsible for learning activities, but becomes more like a manager or group leader, facilitating the learning process. A vital part of this process is to assure that the best available learning materials are accessible to the learner, and to make sure that the learning process is efficient.

D-4. Modify the classroom situation, so that the necessary computer assistance is provided to the group in order to facilitate the learning of relationships.

D-5. The use of resource persons in the classroom should be expanded, while striving to avoid increased costs. The purpose of this is to introduce regional planning materials as a resource for the study of relationships in a relevant setting.

D-6. Additional support must be provided to teachers at the institutional level, to facilitate the transition from normal teaching operations into interdisciplinary learning. This requires that administrators learn the requirements for environmental education, so they can envisage the kind of support that is needed.

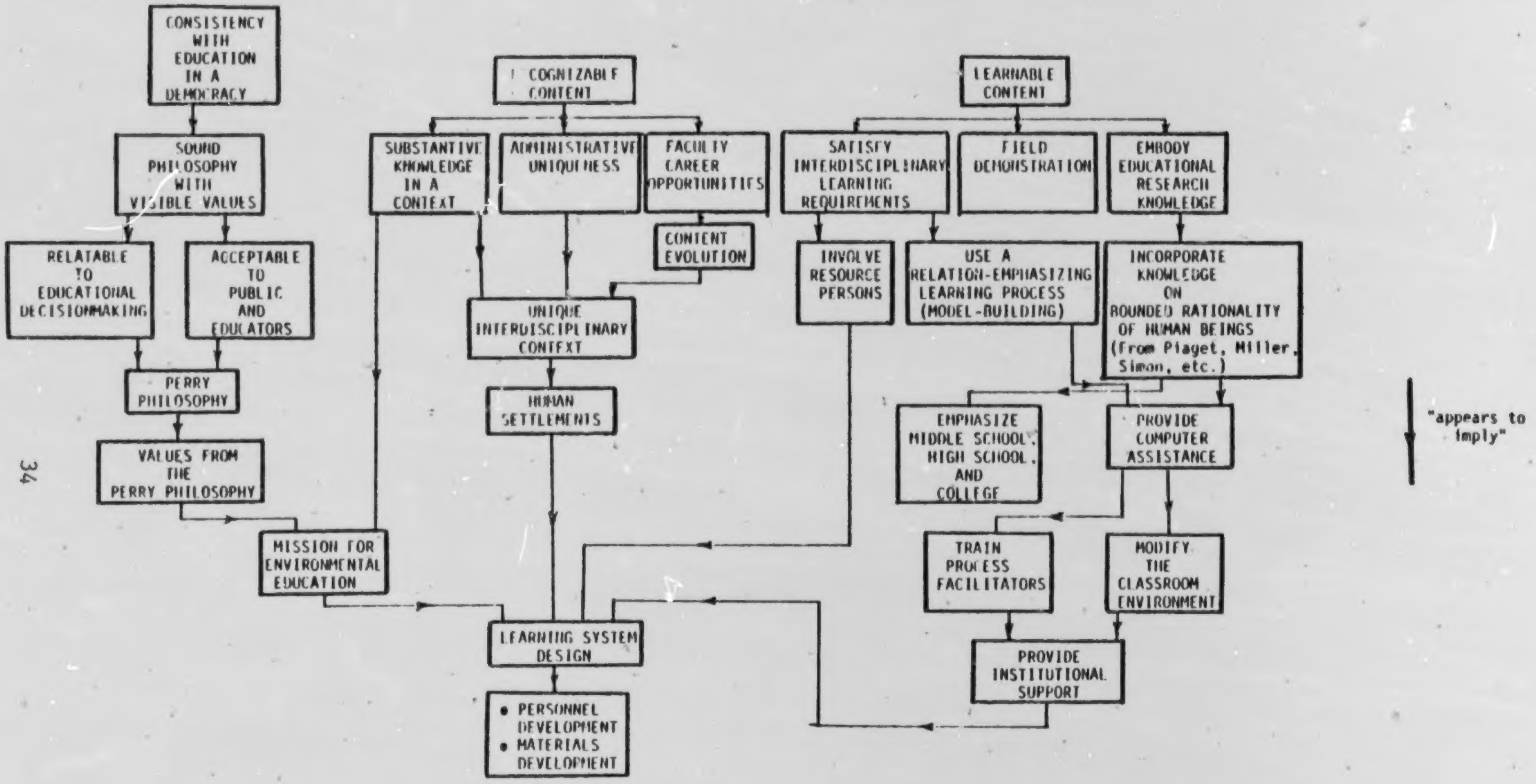
D-7. A training program is needed that will educate teachers, curriculum designers, administrators, and public representatives in the learning and operational requirements for environmental education, and in the manner in which these requirements can be satisfied.

As environmental education evolves, there will be a requirement of the form

D-8. Demonstration projects are needed that make visible the effects of satisfying the requirements of environmental education in such a way that the benefits of doing so can be readily observed.

REQUIREMENTS SUMMARY

In the foregoing, we have outlined primary, secondary, and additional requirements for environmental education. In the next chapter, we suggest that the Perry educational philosophy is appropriate for environmental education, and that the context of human settlements is appropriate as a basis for content evolution. These ideas, together with the requirements mentioned, are summarized in an "implication model" for environmental education, shown in Figure 1.


CONSISTENCY WITH EDUCATION IN A DEMOCRACY
SOUND PHILOSOPHY WITH VISIBLE VALUES
RELATABLE TO EDUCATIONAL DECISIONMAKING
ACCEPTABLE TO PUBLIC AND EDUCATORS
PERRY PHILOSOPHY
VALUES FROM THE PERRY PHILOSOPHY
MISSION FOR ENVIRONMENTAL EDUCATION
COGNIZABLE CONTENT
SUBSTANTIVE KNOWLEDGE IN A CONTEXT
ADMINISTRATIVE UNIQUENESS
FACULTY CAREER OPPORTUNITIES
CONTENT EVOLUTION
UNIQUE INTERDISCIPLINARY CONTEXT
HUMAN SETTLEMENTS
LEARNABLE CONTENT
SATISFY INTERDISCIPLINARY LEARNING REQUIREMENTS
FIELD DEMONSTRATION
EMBODY EDUCATIONAL RESEARCH KNOWLEDGE
INVOLVE RESOURCE PERSONS
USE A RELATION-EMPHASIZING LEARNING PROCESS (MODEL-BUILDING)
INCORPORATE KNOWLEDGE ON BOUNDED RATIONALITY OF HUMAN BEINGS (From Piaget, Miller, Simon, etc.)
EMPHASIZE MIDDLE SCHOOL, HIGH SCHOOL, AND COLLEGE
PROVIDE COMPUTER ASSISTANCE
TRAIN PROCESS FACILITATORS
MODIFY THE CLASSROOM ENVIRONMENT
PROVIDE INSTITUTIONAL SUPPORT
LEARNING SYSTEM DESIGN
• PERSONNEL DEVELOPMENT
• MATERIALS DEVELOPMENT
"appears to imply"

IMPLICATION MODEL FOR ENVIRONMENTAL EDUCATION

Figure 1

For all of the requirements to be satisfied, it seems that it would be highly beneficial to have available an organized description of environmental education arranged in a modular way. The discourse concerning environmental education that is required in order to adapt to local or regional conditions could be encouraged and underpinned. Such a description would also, presumably, have value in organizing future research on environmental education, and in providing background useful for the design of training programs or demonstration projects.

The description should be responsive to all of the requirements outlined in this chapter. Such a description is given in Chapter 3.

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CHAPTER 3

ORGANIZING MODELS FOR ENVIRONMENTAL EDUCATION

INTRODUCTION

Many elements require consideration in environmental education. These elements are related in many ways. It is useful to organize these elements, and to assess their interrelations.

A list of the major sets of elements that have been found important in the study of environmental education is presented in this chapter. Then we show relationships among the elements with the aid of a set of eight organizing models. All of these models are structural models.

One of the models is an integrating model that shows how the other seven models are related.

We do not attempt to show all of the relations that are interesting in any of the models. To do so would be to make them more complex and less useful as a basis for discussion.

A list of references is provided at the end of the chapter that shows where more information can be found on the sets of elements. In the following chapter we connect the organizing models to a collection of reports and self-paced learning units.

THE ORGANIZING SETS

Thirteen sets have been identified as vital in the study of environmental education. The names of these sets are presented in Table 1.

TABLE 1

NAMES OF THIRTEEN ORGANIZING SETS

Democratic Values

Mission Components

Learning System Design Dimensions

Design Options

Components of Content

Focusing Contexts

Facilitating Processes

Types of Relations

Types of Activities

Decision-Making Levels

Decision Areas

System Roles

Constraints

Each of these sets will be described briefly, and then the elements of the sets will be listed.

The Democratic Values represent basic concepts of the purpose of education in a democracy. Major decisions on how education shall be conducted, on objectives to be achieved, on content to be included, on the style with which it is carried out, on how it shall be financed, and on priorities, all stem from a basis in values.

More generally they stem from a philosophy in which a set of values is integrated with some overriding concept of purpose. Often values are not treated explicitly in research studies or discussions of education. But environmental education cannot advance beyond the initial stages of its development unless a set of values is identified that provides a consistent basis for decision making with respect to environmental education and its place in the educational system.

The set of Mission Components is a set of learning outcomes that are envisaged for environmental education. These learning outcomes should be consistent with the philosophy of education in a democracy, as reflected in the Set of Democratic Values. Moreover, when the learning outcomes are connected in an organized way, they form a mission for environmental education.

The set of Learning System Design Dimensions reflects an explicit judgment that for best results in environmental education a learning system needs to be designed that provides the necessary components, suitably interrelated, to make environmental education effective. The set of design dimensions reflects a view that a satisfactory learning system design will require a choice of options from each of the design dimensions, the chosen options forming a mutually consistent and feasible means of carrying out environmental education.

The set of Design Options is partitioned into subsets, one subset for each dimension in the Learning System Design Dimensions.

The set of Components of Content identifies the major content areas germane to environmental education. Environmental education is not merely education -- it is interdisciplinary education. The method of study of any area of interdisciplinary education could be the same as that for environmental education. The uniqueness of environmental education will lie in its content and in those activities that are required to support learning of the specific content of environmental education.

The set of Focusing Contexts identifies umbrella concepts or initiating concepts or themes for the study of environmental education. Content is not learned in a vacuum. The disciplines provide their own contexts, but environmental education requires the definition of a focusing context within or around which a pattern of learning and materials development can be organized. Focusing contexts should be highly relevant to the learner, to accommodate to and motivate a successful learning experience.

Because interdisciplinary education is not well understood, only a few ideas stand out. One of these is the importance of working with relationships among somewhat disparate entitites. Another is the complexity of working with such relationships. Finally there is evidence from numerous research studies that people require considerable assistance in working with complex relationships. For these reasons the set of Facilitating Processes assumes considerable importance, not just with respect to environmental education, but with respect to interdisciplinary education in general.

The disciplines have evolved an understanding of what kinds of relations are important in their study. However interdisciplinary fields in general, and environmental education in particular, require attention specifically to what types of relations will be studied in exploring the components of content. For this reason, special concern is directed to Types of Relations.

The management and operation of an environmental learning system requires a concept of an interrelated set of activities that provide systemic character and mutual support. Without these, any kind of education proves to be fragmented, often ineffective, and very hard to evaluate in a constructive way. Thus a set of Types of Activities has been identified and elaborated.

In planning, implementing, and operating a system of environmental education, a division of labor is needed. This is true not only in terms of the work to be done, but also in terms of the decisions to be made. It is helpful to identify Decision-Making Levels in the educational system, so that specific responsibilities can be attached to the appropriate levels, consonant with the mission and values of environmental education.

Certain types of decisions require particular kinds of support materials and background information. Moreover certain types of decisions hinge on other types of decisions. For these reasons, out of the myriad types of decisions that are made in education, we have identified four Decision Areas that are especially important in advancing environmental education from its initial stages of development. This allows us later to connect particular research results to particular decision areas.

A satisfactory learning system design requires an identification of specific roles, especially as the design effort is initiated and moves into implementing and operating phases. The role identification and definition provide a basis for personnel selection and development, and suggest the kind of preparation that is needed to carry out environmental education. The System Roles cannot all be uniformly specified for all situations. It is largely a local responsibility to work out the roles that are needed to initiate, implement, and operate a locally-designed environmental learning system.

Constraints are always present that prevent doing everything that might be desired. Like the System Roles, the set of Constraints is likely to be largely locale-specific, and will play a very important part in environmental education. The limitation on the capacity of human beings to work mentally with large sets of elements and relations among them is one constraint that is universal. The implications of this particular constraint should be recognized in the design of learning systems and in classroom and community learning situations.

The sets just described have originated from various sources. The Democratic Values are extracted from a philosophy of education for democracy developed by a practicing philosopher (Ralph Barton Perry). Several sets were taken from the literature of environmental education: Mission Components, the Components of Content, the Focusing Contexts, and the Types of Activities. Sets developed through research include: Learning System Design Dimensions, Design Options, Facilitating Processes, Types of Relations, Decision-Making Levels, and Decision Areas. More detail on the sources of the sets is provided in the list of references at the end of the chapter.

Table 2 identifies the elements of the various sets.

TABLE 2

ELEMENTS OF THE ORGANIZING SETS

A. DEMOCRATIC VALUES

a_1. Democratic political system

a_2. Individual interests are related to the interests of others

a_3. Presumption of capacity of each individual to contribute to building a superior society

a_4. Presumption that people are the architects of order

a_5. Knowledge of the cultural inheritance

a_6. Preparation for participation in the contemporary world

a_7. Preparation to contribute to future civilization

a_8. Realistic understanding of the environment

a_9. Self-comprehension of one's own values and priorities, both as they are and as they ought to be

a_{10}. Free inquiry

a_{11}. Learning how to learn

a_{12}. Testing one's priorities against those of others

a_{13}. Structuring a benevolent society

a_{14}. Reasonableness, demonstrated by generating and testing rationale for decision-making

a_{15}. Factual knowledge, when available, takes precedence over hope and taste

a_{16}. Agreement on how decisions will be reached

TABLE 2 (CONTINUED)

B. MISSION COMPONENTS (LEARNING OUTCOMES SOUGHT FROM ENVIRONMENTAL EDUCATION)

b_1. To analyze complex systems

b_2. To synthesize concepts from many different disciplines

b_3. To know environmental concepts and principles

b_4. To acquire skills in data collection on environmental issues

b_5. To situate environmental issues in the next larger context

b_6. To structure the elements of the environment into coherent patterns

b_7. To identify important elements of the environment

b_8. To be sensitive to different societal perspectives

b_9. To acquire insights for environmental analysis

b_{10}. To understand linkages among local, national, and international issues

b_{11}. To be aware of the complex interactions and interdependencies of environmental elements

b_{12}. To analyze environmental systems

b_{13}. To be aware of international interdependence

b_{14}. To understand impacts of human acts on the environment

b_{15}. To develop an integrated appreciation for one's environment

b_{16}. To assess the long-term impact of personal and occupational decisions

b_{17}. To be aware of career opportunities in the environmental area

TABLE 2 (CONTINUED)

b_{18}. To know methodology for resolving environmental issues

b_{19}. To be aware of important environmental issues

b_{20}. To diagnose environmental issues

b_{21}. To value a harmonious relationship with the environment

b_{22}. To identify alternative resolutions of environmental issues

b_{23}. To assess alternative resolutions of environmental issues

b_{24}. To choose between alternative resolutions of environmental issues

b_{25}. To be concerned about the present and future material and spiritual needs of humankind

b_{26}. To be concerned about better relations between people and their environment

b_{27}. To foster better relations between people and their environment

b_{28}. To be actively involved in local environmental issues

b_{29}. To develop sound environmental goals

b_{30}. To develop strategies to resolve environmental issues

b_{31}. To resolve environmental issues

b_{32}. To develop sound environmental policy

b_{33}. To assume responsibility for environmental preservation and development

b_{34}. To sustain the human environment

b_{35}. To manage responsibly the human environment

b_{36}. To sustain and enhance human development

TABLE 2 (CONTINUED)

C. LEARNING SYSTEM DESIGN DIMENSIONS

c_1 . Basic learning outcomes sought

c_2 . Presumed learning style

c_3 . Presumed learner skills base

c_4 . Mode of environmental education

c_5 . Type of environmental education

c_6 . Mediator model

c_7 . Learner interaction resources

c_8 . Source of information

c_9 . Curriculum delivery concept

c_{10}. Origin of financing

D. DESIGN OPTIONS

The design options appear under the respective Learning System Design Dimensions on the Options Field, Figure 6.

E. COMPONENTS OF CONTENT

e_1 . Natural surroundings

e_2 . Built environment

e_3 . Population

e_4 . Pollution

e_5 . Energy

e_6 . Resource allocation and depletion

e_7 . Conservation

e_8 . Transportation

TABLE 2 (CONTINUED)

- e_9. Technology
- e_{10}. Economic impact
- e_{11}. Urban and rural planning
- e_{12}. Total human environment
- e_{13}. The human

F. FOCUSING CONTEXTS

- f_1. Human settlements (formal education sector)
- f_2. Environmental issues (informal education sector)

G. FACILITATING PROCESSES

- g_1. Ideawriting (Brainwriting)
- g_2. Nominal Group Technique (NGT)
- g_3. Content analysis of literature
- g_4. Interpretive Structural Modeling (ISM)
- g_5. Charette

H. TYPES OF RELATIONS

- h_1. Comparative
- h_2. Definitive
- h_3. Influence
- h_4. Spatial
- h_5. Temporal
- h_6. Mathematical dependency

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TABLE 2 (CONTINUED)

I. TYPES OF ACTIVITIES

- i_1. Planning activities
- i_2. Learning systems design activities
- i_3. Personnel development activities
- i_4. Learning activities
- i_5. Delivery system and support activities
- i_6. Evaluation activities

J. DECISION-MAKING LEVELS

- j_1. The society
- j_2. The institution
- j_3. The administration level
- j_4. The instructional level
- j_5. The learning experience level
- j_6. The individual level

K. DECISION AREAS

- k_1. Social contract decisions
- k_2. Learning system design decisions
- k_3. Curriculum design decisions
- k_4. Operating decisions

M. SYSTEM ROLES

- m_1. Regional broker
- m_2. Provider of technical assistance
- m_3. Learning system schools coordinator

TABLE 2 (CONTINUED)

m_4. Learning system community coordinator

m_5. Mission specialist

m_6. Content specialist

m_7. Learning process specialist

m_8. Learning system design leader

m_9. Learning system design participant

m_{10}. Proposal 1 leader

m_{11}. Proposal 2 leader

m_{12}. Teacher

m_{13}. Computer process technician

N. CONSTRAINTS

To be locally or regionally defined.

References to origins and details of the various sets appear at the end of this chapter.

EIGHT MAJOR MODELS

Definition of sets, by itself, is inadequate as a basis for exploring environmental education. It is necessary to develop relationships among the members of the sets in a variety of ways, in order to help organize the discourse that leads to decision making and action.

In our study, we have been impressed with the large number and the variety of models that have been developed for environmental education. The sheer numbers present difficulties. We have elected to focus on eight major models as a basis for organization. These models do not exhaust the universe of useful models. They reflect a compromise between an overly global approach and an overly detailed approach.

Table 3 lists the names of the eight major models chosen.

TABLE 3

NAMES OF EIGHT MAJOR MODELS
Value Model
Mission Model
Content Model
Learning System Design Model
Decision Area Model
Operating Model
Decision Structure Model
Integrating Model

The Integrating Model

The Integrating Model is intended to show how the other major models relate to each other. It appears in Figure 2. This model is a six-level structure, each level in the structure being informed by (and, in a sense, being dominated by) all of the levels below it. Notice that the Value Model should inform all of the other levels.

INTEGRATING MODEL

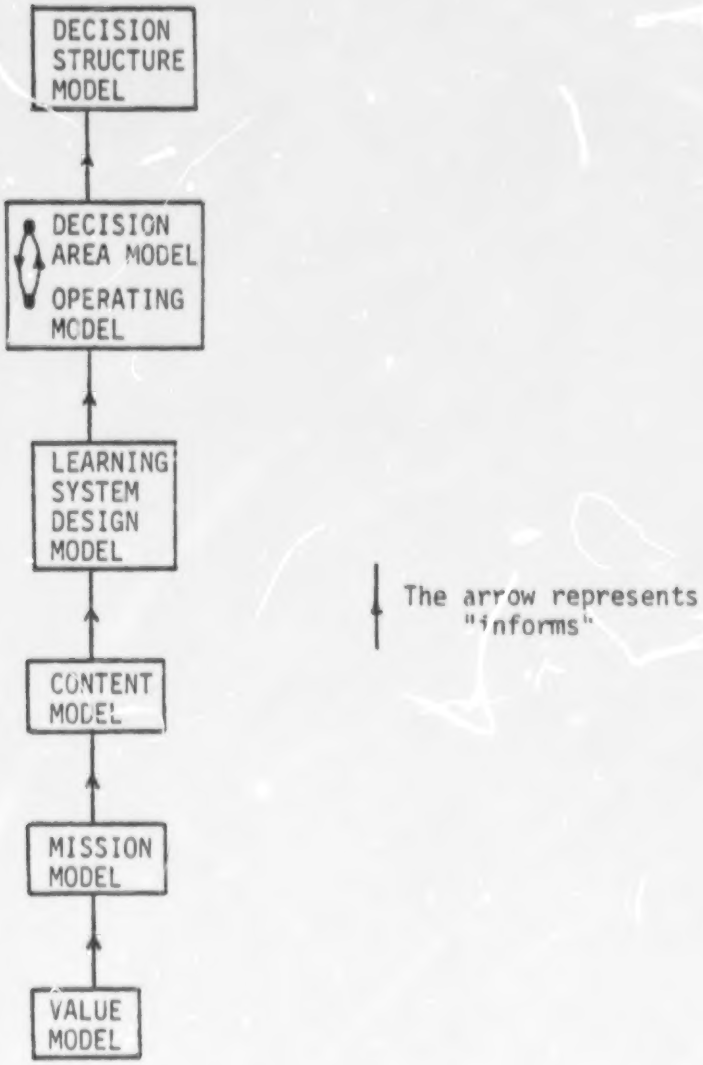
DECISION STRUCTURE MODEL
DECISION AREA MODEL
OPERATING MODEL
LEARNING SYSTEM DESIGN MODEL
CONTENT MODEL
MISSION MODEL
VALUE MODEL
The arrow represents "informs"

Figure 2

The Value Model

The Value Model appears in Figure 3. This model shows the Democratic Values set being partitioned into five value classes.

The democratic political system is shown as the value that links education to the societal context in which it takes place.

A relational value expresses the importance of individual interests being related to the interests of others.

Two people-related values appear. One expresses a presumption of the capacity of each individual to contribute toward building a superior society. The other expresses a presumption that people are the architects of order.

Five content-related values appear. These stress the past (learning the cultural inheritance), the present (learning to participate in the contemporary world), and the future (developing an interest in and capacity for contributing to future civilization). Also expressed is the value of a realistic understanding of the environment, and developing a commitment to and capacity for understanding how to deal with one's own values and priorities. In the latter it is vital to develop the ability to comprehend not only what these values and priorities are, but also to have a willingness to assess what they ought to be in the light of the obligation to society as a whole.

Seven process values with behavioral implications appear. These are maintaining a commitment to free inquiry, learning how to learn, testing one's priorities against those of others, working to structure a benevolent society through education, showing reasonableness

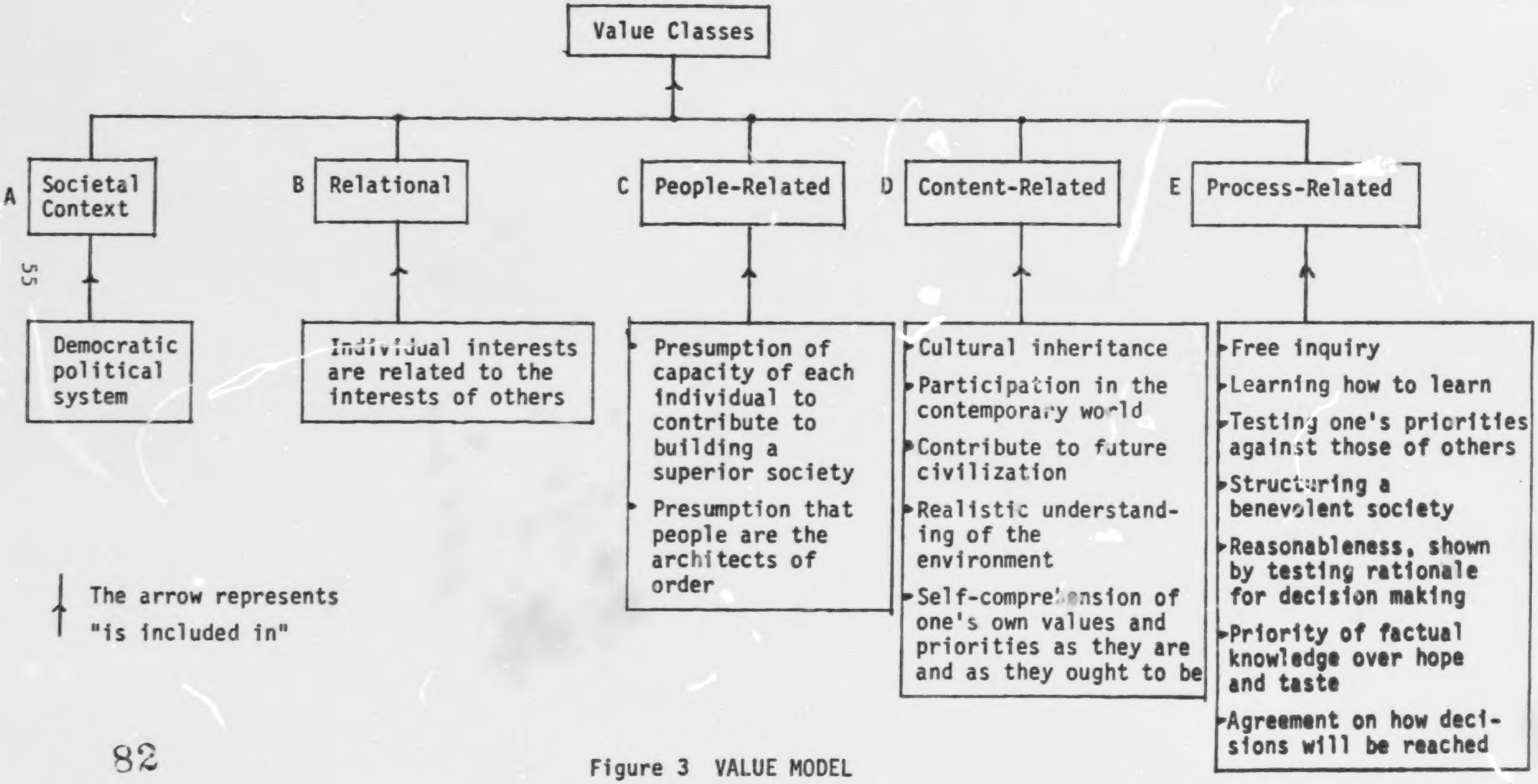
Value Classes
A Societal Context
B Relational
C People-Related
D Content-Related
E Process-Related
Democratic political system
Individual interests are related to the interests of others
Presumption of capacity of each individual to contribute to building a superior society
Presumption that people are the architects of order
Cultural inheritance
Participation in the contemporary world
Contribute to future civilization
Realistic understanding of the environment
Self-comprehension of one's own values and priorities as they are and as they ought to be
Free inquiry
Learning how to learn
Testing one's priorities against those of others
Structuring a benevolent society
Reasonableness, shown by testing rationale for decision making
Priority of factual knowledge over hope and taste
Agreement on how decisions will be reached
The arrow represents "is included in"

Figure 3 VALUE MODEL

as demonstrated by willingness and inclination to develop and test rationale for decision making, lending priority to factual knowledge over hope and taste, and promoting agreement on how decisions will be reached.

The Value Model is not specific to environmental education. Specificity is achieved in the Mission Model, which is considered next.

The Mission Model

Early in the study of environmental education, a "normative model of environmental education" was developed. This work was reported by Fitz, Troha and Wallick (see the references at the end of the chapter). The normative model also has been called the "Big Map" of environmental education.

The normative model consisted of seven aggregated blocks, each of which was detailed in the report mentioned. Of these seven blocks, one represented the desired learning outcomes from environmental education. The other six blocks represented activities deemed necessary to achieve the learning outcomes.

In the present report, the normative model is separated into two parts. One part, representing the learning outcomes, is the Mission Model. The other, representing the needed activities, is the Operating Model.

It is not possible in this report to present all of the details concerning the normative model, even when separated into two parts.

The Mission Model appears in Figure 4. The lower part of this model relates to learning outcomes for the individual, while the upper part relates to learning outcomes relevant to the society.

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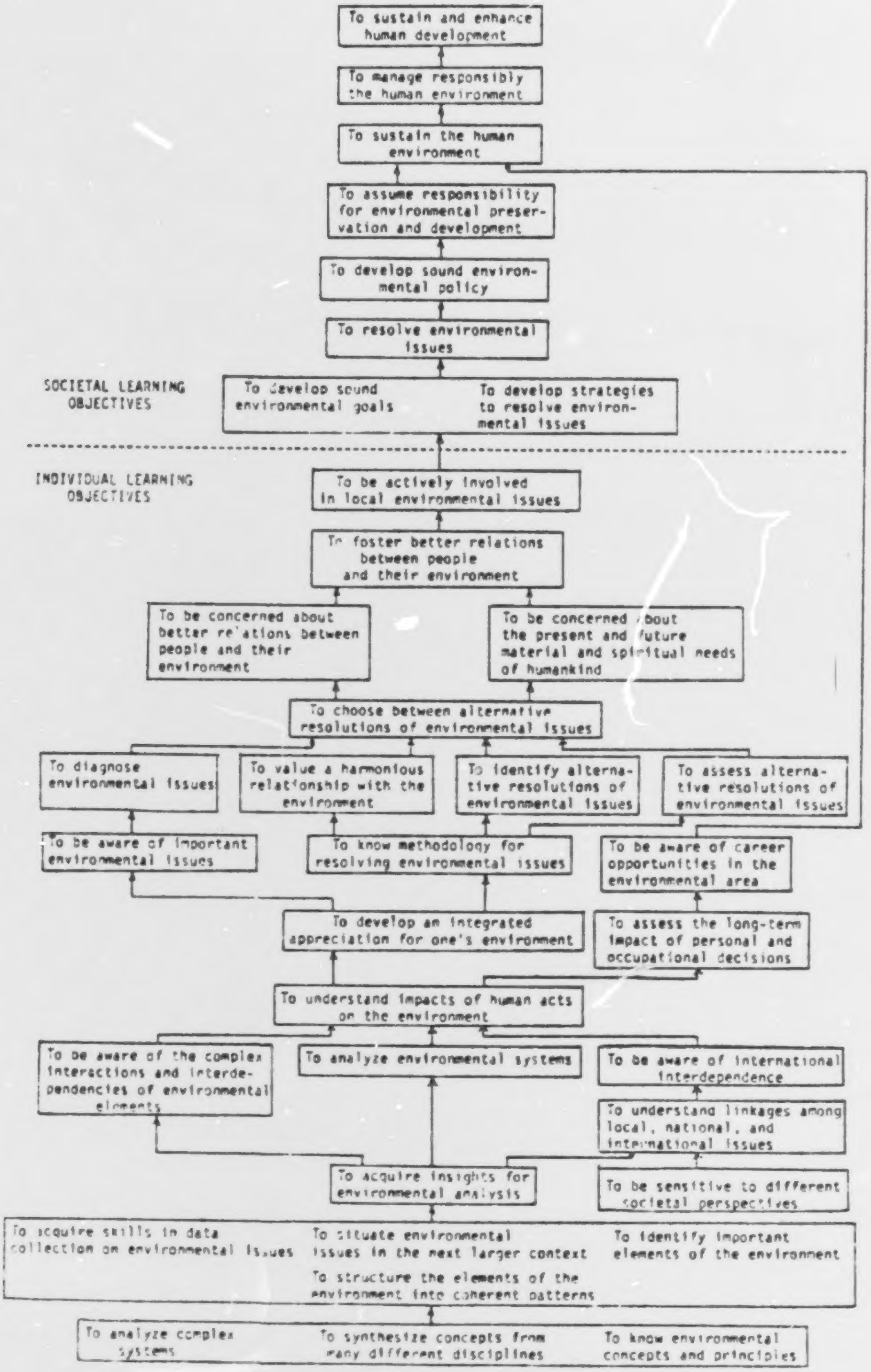

To sustain and enhance human development
To manage responsibly the human environment
To sustain the human environment
To assume responsibility for environmental preservation and development
To develop sound environmental policy
To resolve environmental issues
SOCIETAL LEARNING OBJECTIVES
To develop sound environmental goals
To develop strategies to resolve environmental issues
INDIVIDUAL LEARNING OBJECTIVES
To be actively involved in local environmental issues
To foster better relations between people and their environment
To be concerned about better relations between people and their environment
To be concerned about the present and future material and spiritual needs of humankind
To choose between alternative resolutions of environmental issues
To diagnose environmental issues
To value a harmonious relationship with the environment
To identify alternative resolutions of environmental issues
To assess alternative resolutions of environmental issues
To be aware of important environmental issues
To know methodology for resolving environmental issues
To be aware of career opportunities in the environmental area
To develop an integrated appreciation for one's environment
To assess the long-term impact of personal and occupational decisions
To understand impacts of human acts on the environment
To be aware of the complex interactions and interdependencies of environmental elements
To analyze environmental systems
To be aware of international interdependence
To understand linkages among local, national, and international issues
To acquire insights for environmental analysis
To be sensitive to different societal perspectives
To acquire skills in data collection on environmental issues
To situate environmental issues in the next larger context
To identify important elements of the environment
To structure the elements of the environment into coherent patterns
To analyze complex systems
To synthesize concepts from many different disciplines
To know environmental concepts and principles

MISSION MODEL

The arrow means
"should help achieve"

Figure 4

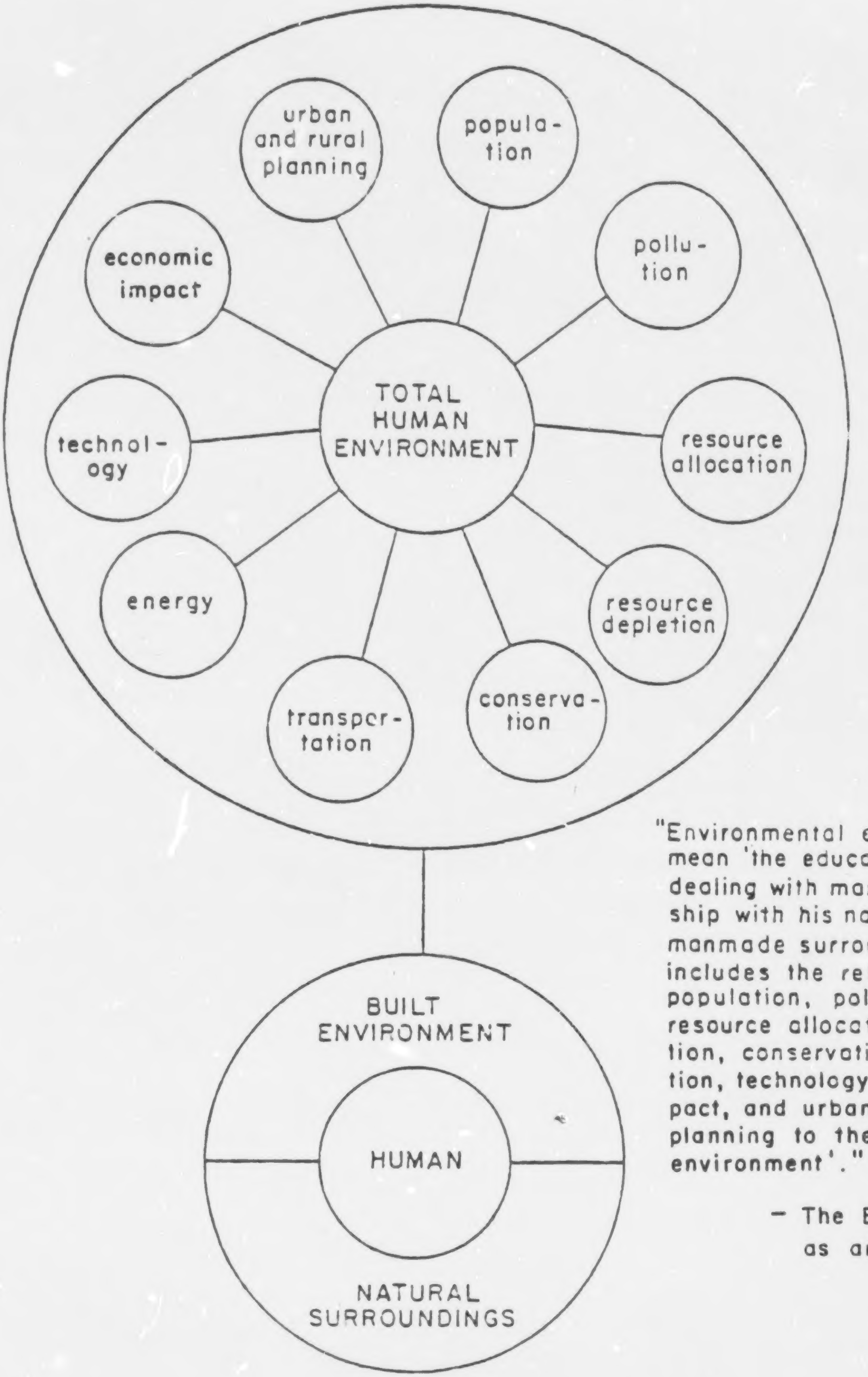
Environmental education is carried out in both formal and non-formal settings. The formal settings are those in educational institutions. The non-formal settings occur whenever environmental issues are discussed in the society. The Mission Model is intended to represent both the formal and non-formal educational settings, through the learning outcomes sought.

Content Model

The Content Model, represented in Figure 5, shows the components of content linked by hypothesized but unspecified relationships. The dual emphasis upon the individual human being and the society, the latter represented by the "total human environment," is reflected in the Content Model. This same emphasis is represented in the Perry philosophy, the Value Model, and the Mission Model.

The Content Model is supported by the set of Types of Relations. The study of relations among and within components comprises the bulk of environmental education.

The Content Model is also supported by the concept of Focusing Contexts. For the formal education sector, the theme "human settlements" is recommended. This theme places the "total human environment" in the context where people live. This theme also can be a rallying point for academic researchers, who can convert it into a respectable body of knowledge (over a period of decades, perhaps).


urban and rural planning
population
pollution
economic impact
TOTAL HUMAN ENVIRONMENT
technology
resource allocation
energy
resource depletion
conservation
transportation
BUILT ENVIRONMENT
HUMAN
NATURAL SURROUNDINGS

"Environmental education shall mean 'the educational process dealing with man's relationship with his natural and manmade surroundings, and includes the relation of population, pollution, energy, resource allocation and depletion, conservation, transportation, technology, economic impact, and urban and rural planning to the total human environment'."

— The EE Act of 1970, as amended.

CONTENT MODEL Figure 5

For the non-formal sector, issues are recommended as focusing contexts. However one will typically build content around an issue, while it can be built within the context of human settlements. Notice that all of the components of content can be integrated within the human settlements theme. Also this context allows the educational content to be harmonized with human beings, every one of whom needs to understand his or her human settlement and that of others, as a fundamental part of living.

Learning System Design Model

The Learning System Design Model stresses the use of the Options Field shown in Figure 6. The Options Field is recommended as a basis for design of learning systems. It has ten design dimensions represented by the letters A-J inclusive. Under each dimension there appear various options.

A complete design will draw at least one option from each of the dimensions.

Supporting the Options Field, as part of the Learning System Design Model, are design methods and processes. These are intended to be used by a group with a facilitator, who uses the methods to help the group develop a learning system design.

Details of the methods appear in the references.

A BASIC LEARNING OUTCOMES SOUGHT

- TO BE ABLE TO SYNTHESIZE CONCEPTS FROM MANY DISCIPLINES
- TO BE ABLE TO SITUATE ENVIRONMENTAL ISSUES IN THE NEXT LARGER CONTEXT
- TO BE ABLE TO ANALYZE COMPLEX SYSTEMS
- TO BE ABLE TO STRUCTURE ELEMENTS OF THE ENVIRONMENT INTO COHERENT PATTERNS
- TO KNOW ENVIRONMENTAL CONCEPTS AND PRINCIPLES
- TO ACQUIRE SKILLS IN DATA COLLECTION ON ENVIRONMENTAL ISSUES
- TO BE ABLE TO IDENTIFY IMPORTANT ELEMENTS OF THE ENVIRONMENT

B PRESUMED LEARNING STYLE

- LEARNS UNRELATED CONCEPTS
- LEARNS IN THE REPRESENTATIONAL STYLE (TWO INTERRELATED CONCEPTS)
- LEARNS THROUGH FORMAL OPERATIONS

C PRESUMED LEARNER SKILLS BASE

- CAN READ PROSE
- CAN WRITE
- CAN USE SPECIFIED MATHEMATICS
- CAN READ TRANSLATABLE GRAPHICS

D MODE OF ENVIRONMENTAL EDUCATION

- HOLISTIC
- ISSUE-ORIENTED
- PROCESS-ORIENTED
- BACKGROUND DEVELOPMENTAL
- OUTDOOR EXPERIENTIAL

E TYPE OF ENVIRONMENTAL EDUCATION

- COMMUNITY EE
- FORMAL POST-SECONDARY EE
- FORMAL SECONDARY EE
- FORMAL ELEMENTARY EE

TIE LINE

F MEDIATOR MODEL

- LEARNING PROCESS MANAGER
- GROUP DISCUSSION LEADER
- FIELD GUIDE AND INTERPRETER
- CLASSROOM LECTURER

G LEARNER INTERACTION RESOURCES

- BUILT ENVIRONMENT
- NATURAL ENVIRONMENT
- COMPUTER-ASSISTED PROCESSES
- AUDIO-VISUALS
- PRINT MODULES
- PHYSICAL MODULES

H SOURCE OF INFORMATION

- ISSUE-ORIENTED MATERIALS
- REGIONAL PLANNING MATERIALS
- CORE THEME MATERIALS
- STANDARD TEXTBOOKS

I CURRICULUM DELIVERY CONCEPT

- APPEND NEW EE COURSE OR PROGRAM TO EXISTING CURRICULUM
- INFUSE "MINI-MODULES" INTO EXISTING COURSES
- INFUSE AND INTEGRATE EE WITH VARIOUS SUBJECTS IN THE CURRICULUM
- TREAT EE AS A CONTEXT INTO WHICH OTHER SUBJECT MATTERS ARE INFUSED AND INTEGRATED

J ORIGIN OF FINANCING

- LOCAL TAX FUNDS
- STATE TAX FUNDS
- FEDERAL TAX FUNDS
- PRIVATE FUNDS
- IN-KIND GIFTS

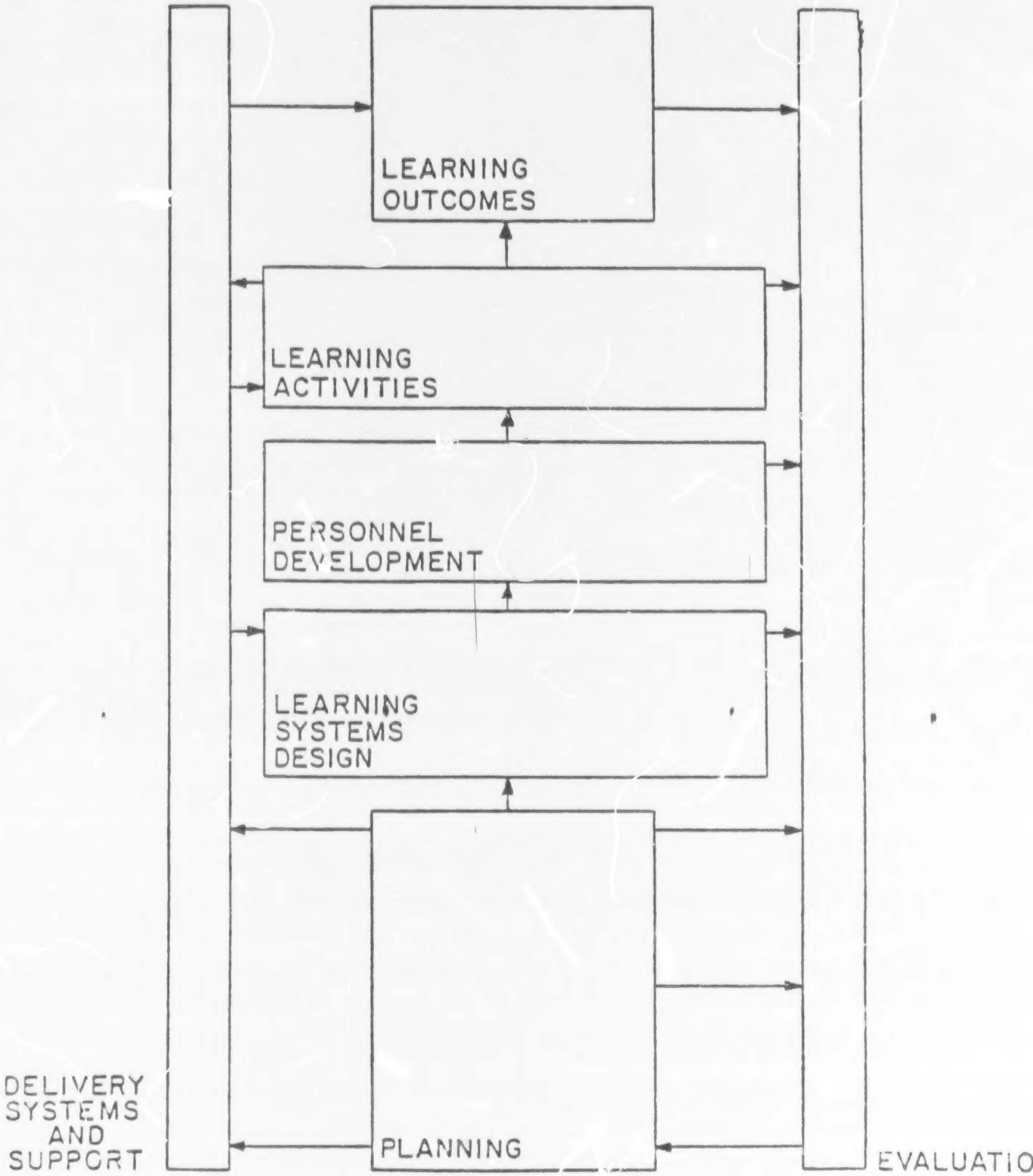
OPTIONS FIELD FOR
REGIONAL ENVIRONMENTAL LEARNING SYSTEM

LEARNING SYSTEM DESIGN MODEL Figure 6
(Related processes are discussed in a referenced report.)

Operating Model

Figure 7 shows the framework of the Operating Model. A more detailed version of this model appears in the references.

Planning helps develop a process for Learning System Design. Learning System Design provides the basis for Personnel Development. The latter develops the people who bear responsibility for the Learning Activities. The Learning Activities are intended to achieve the Learning Outcomes. Delivery Systems and Support make possible the Learning Activities. Evaluation links the Learning Activities and Learning Outcomes with Planning for further system improvement.


LEARNING OUTCOMES
LEARNING ACTIVITIES
PERSONNEL DEVELOPMENT
LEARNING SYSTEMS DESIGN
PLANNING
DELIVERY SYSTEMS AND SUPPORT
EVALUATIO

OPERATING MODEL Figure 7

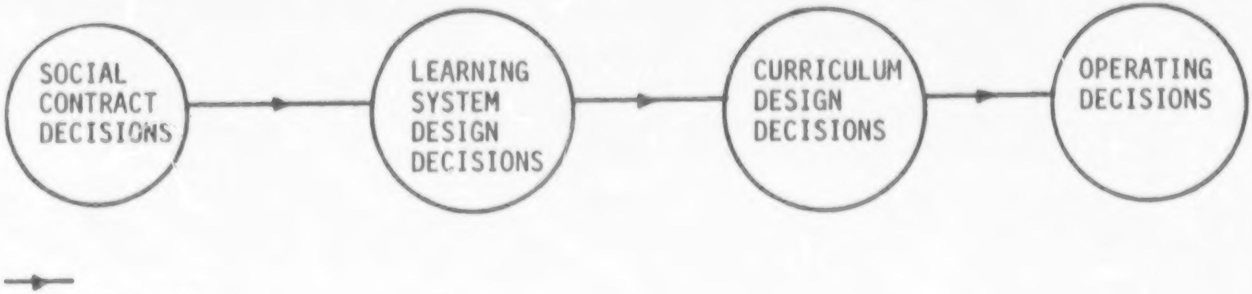
The arrow means "should help achieve".
The Learning Outcomes constitute the Mission Model.
Additional detail is available on the activities from a reference report.

Decision Area Model

Figure 8 shows the Decision Area Model. This model is needed to make it possible to organize research results in such a way that persons who are involved in decision-making in the various areas can see how the research results are connected to the areas. This allows them to focus their attention especially on those parts of the research results that are germane to particular decision areas, while helping to envisage interactions with other decision areas.

The four decision areas selected are:

- Social contract decisions, relating to how the institution interacts with the society, and to what philosophy and values are used in establishing the mission for environmental education, as well as to other major decisions pertaining to environmental education
- System design decisions, relating to how the learning system is to be designed to make environmental education effective, the choices that go into system design, and the way research knowledge is applied in allocating funds for educational purposes
- Curriculum design decisions, relating to how content will be developed and integrated into the curriculum, how a context can be adopted that will provide a framework for learning and retention, and how relations can be explored in an interdisciplinary learning experience


SOCIAL CONTRACT DECISIONS
LEARNING SYSTEM DESIGN DECISIONS
CURRICULUM DESIGN DECISIONS
OPERATING DECISIONS

The arrow represents "informs"

Figure 8

DECISION AREA MODEL

- Operating decisions, providing a basis for day-to-day management consistent with planning, learning system design, and curriculum design, across the decision-making levels

Decision Structure Model

A decision structure model is shown in Figure 9. This model of decision structure in the educational system is needed to have a vocabulary for relating different kinds of responsibilities and decisions to different parts of the educational system. Also the Decision Structure Model can be used in studying correlations between the levels and other models.

The model contains six decision levels in the educational system, which are:

- The society
- The institutional level
- The administrative level
- The instructional level
- The learning experience level
- The individual level

This model is adapted from two models of decision structure, one developed by Banathy, Mills, and Aaron, and the other developed by Atkin. Both sources are given in the references at the end of this chapter.

DECISION STRUCTURE MODEL

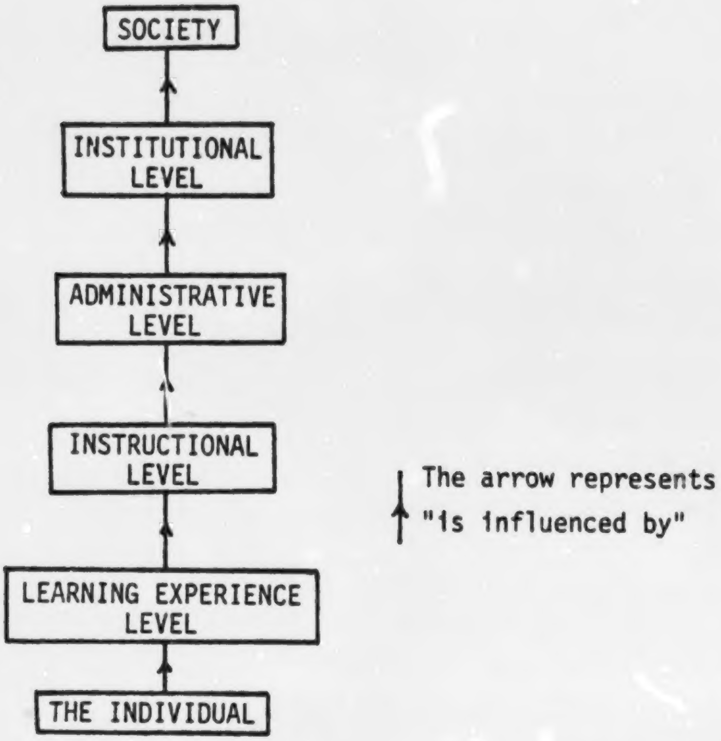

SOCIETY
INSTITUTIONAL LEVEL
ADMINISTRATIVE LEVEL
INSTRUCTIONAL LEVEL
LEARNING EXPERIENCE LEVEL
THE INDIVIDUAL
The arrow represents "is influenced by"

Figure 9

ROLE-ROLE AND ROLE-MODEL INTERACTIONS

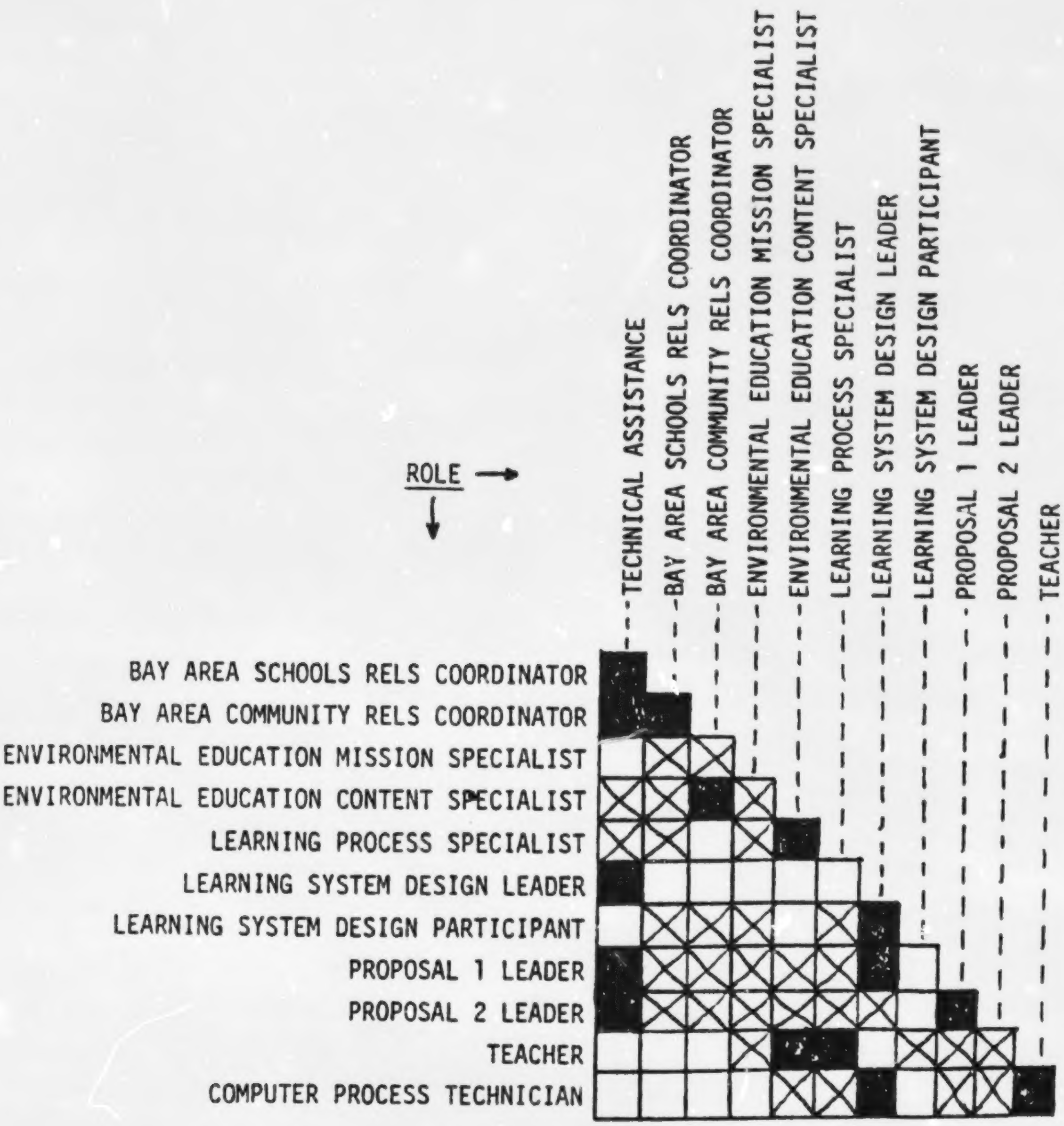
It seems worthwhile to discuss how various roles might interact with each other and with the several models. There are at least two objections to doing this. First, the detailed roles to be filled depend on local or regional situations, hence any role specification will be of somewhat limited generality. Second, by specifying roles we may seem to be dictating too specifically what shall go on in the educational system.

It is our purpose here to discuss role-role and role-model interactions for illustrative purposes only. We present a role-role interaction chart developed specifically for the San Francisco Bay Area, along with a discussion of the anticipated interactions.

We also present a role-model interaction chart, primarily to help persons interested in specific roles gain a tentative understanding of which models appear to be especially relevant to particular roles.

The role of Broker is one of identifying and bringing together the persons who will be working together to develop a Regional Environmental Learning System (RELS) in some locale.

The Technical Assistance role provides technical assistance to all other roles. The strongest interaction of this role is with the coordinators, the learning system design leader, and the proposal leaders. Figure 10 indicates the strong interactions, moderate interactions, and modest interactions required from the technical assistance role, as envisaged for a possible San Francisco Bay Area RELS. (Because the relations are symmetrical, Figure 10 has a triangular rather than square shape.)



ROLE	TECHNICAL ASSISTANCE	BAY AREA SCHOOLS RELS COORDINATOR	BAY AREA COMMUNITY RELS COORDINATOR	ENVIRONMENTAL EDUCATION MISSION SPECIALIST	ENVIRONMENTAL EDUCATION CONTENT SPECIALIST	LEARNING PROCESS SPECIALIST	LEARNING SYSTEM DESIGN LEADER	LEARNING SYSTEM DESIGN PARTICIPANT	PROPOSAL 1 LEADER	PROPOSAL 2 LEADER	TEACHER
BAY AREA SCHOOLS RELS COORDINATOR	■										
BAY AREA COMMUNITY RELS COORDINATOR	■	■									
ENVIRONMENTAL EDUCATION MISSION SPECIALIST	□	☒	☒								
ENVIRONMENTAL EDUCATION CONTENT SPECIALIST	☒	☒	■	☒							
LEARNING PROCESS SPECIALIST	☒	☒	□	☒	■						
LEARNING SYSTEM DESIGN LEADER	■	□	□	□	□	□					
LEARNING SYSTEM DESIGN PARTICIPANT	□	☒	☒	☒	□	☒	■				
PROPOSAL 1 LEADER	■	☒	☒	☒	☒	☒	■	□			
PROPOSAL 2 LEADER	■	☒	☒	☒	☒	☒	☒	□	■		
TEACHER	□	□	□	☒	■	■	□	☒	☒	☒	
COMPUTER PROCESS TECHNICIAN	□	□	□	□	☒	☒	■	□	☒	☒	■

Figure 10 ROLE INTERACTIONS CHART FOR BAY AREA RELS DESIGN AND IMPLEMENTATION

■ - STRONG INTERACTION NEEDED

☒ - MODERATE INTERACTION NEEDED

□ - MODEST INTERACTION SHOULD SUFFICE

The Schools Coordinator is expected to maintain an overview of what is going on in the RELS activity, as a representative of the schools. A part of this responsibility is to identify persons who are best suited to fill other roles, and to encourage them to participate. Another part is to interact with the Technical Assistance role to make sure that maximum assistance is provided, and to coordinate with the Community Coordinator role so that the effort proceeds with coordinated and harmonious cooperation among the schools and the community. Figure 11 indicates how this role may interact with the several models discussed earlier.

The Community Coordinator role is parallel to that of the Schools Coordinator, except that the Community Coordinator represents the community. In addition this role interacts with persons in the community (such as regional planners, public officials, and others) who are able to provide relevant content knowledge to help satisfy the need for information germane to the Content Model.

The Mission Specialist is one who will become thoroughly familiar with the Value Model and the Mission Model, and who will regularly communicate and explain this model to other roles.

The Content Specialist assumes responsibility for gathering and organizing content materials, based on the Content Model for environmental education; for explaining the context of human settlements; and for serving as an information resource relative to context and content for other roles.

The Learning Process Specialist will be thoroughly familiar with the results of research on human learning and development, and will understand the implications of this research for interdisciplinary education. This person will convey this understanding to other roles, so that it can be used in decisionmaking.

ROLE

MODEL	TECHNICAL ASSISTANCE	BAY AREA SCHOOLS RELS COORDINATOR	BAY AREA COMMUNITY RELS COORDINATOR	ENVIRONMENTAL EDUCATION MISSION SPECIALIST	ENVIRONMENTAL EDUCATION CONTENT SPECIALIST	LEARNING PROCESS SPECIALIST	LEARNING SYSTEM DESIGN LEADER	LEARNING SYSTEM DESIGN PARTICIPANT	PROPOSAL 1 LEADER	PROPOSAL 2 LEADER	TEACHER	COMPUTER PROCESS TECHNICIAN
IMPLICATION MODEL	X	X	X	X	X	X	X	X	X	X	X	
INTEGRATIVE MODEL	X	X	X	X			X		X	X		
VALUE MODEL	X	X	X	X			X	X	X	X	X	
MISSION MODEL	X			X			X	X	X	X	X	
CONTENT MODEL	X		X		X	X	X	X	X	X	X	
LEARNING SYSTEM DESIGN MODEL	X						X		X	X		
OPTIONS FIELD	X	X	X	X			X	X				X
LEARNING SYSTEM DESIGN METHODS	X						X					
SOCIAL CONTRACT DECISIONS	X	X	X	X					X	X		
LEARNING SYSTEM DESIGN DECISIONS	X						X	X	X	X	X	X
CURRICULUM DESIGN DECISIONS	X				X	X	X		X			
OPERATING DECISIONS	X	X							X	X		
DECISION AREA MODEL	X	X	X				X		X	X		
OPERATING MODEL	X	X							X	X		
DECISION STRUCTURE MODEL	X		X						X	X		
PLANNING ACTIVITIES	X	X	X						X	X		
LEARNING SYSTEM DESIGN ACTIVITIES	X			X	X	X		X				X
PERSONNEL DEVELOPMENT ACTIVITIES	X				X	X			X	X		
LEARNING ACTIVITIES	X				X	X			X	X	X	X
DELIVERY SYSTEM AND SUPPORT ACTIVITIES	X	X	X			X	X		X			
EVALUATION ACTIVITIES	X		X						X	X		

Figure 11 MODEL-ROLE INTERACTIONS NEEDED FOR RELS DESIGN AND IMPLEMENTATION

The Learning System Design Leader will provide group leadership in designing the RELS. This role will require familiarity with the design process, and will require support from the Broker role and the Technical Assistance role, among others.

The Learning System Design Participant will join with others in designing the RELS. As a group, the participants should reflect knowledge of the schools and the community, and should have sufficient credibility that a design which they configure would be taken very seriously by those who will be involved in implementation.

The Proposal 1 Leader role involves writing a proposal for support of the RELS design effort and for a prototype trial in the region.

The Proposal 2 Leader will be responsible for taking the results of the prototype effort and generalizing the results into a proposal for the entire region.

The Teacher role generally will be required to benefit from personnel development tailored to the needs of interdisciplinary learning, and to develop the capacity to manage this kind of learning in the classroom.

The Computer Process Technician role provides necessary support to the learning system design activity, and to classroom learning of environmental education content in the context of human settlements.

Figures 10 and 11 show role-role interactions and role-model interactions for all these roles. In addition, Figure 11 shows role interactions with components of the Operating Model.

REFERENCES TO SETS

A. DEMOCRATIC VALUES

- Ira Steinberg, Ralph Barton Perry on Education for Democracy, The Ohio State University Press, 1970.
- Self-Paced Learning Unit, The Perry Educational Philosophy, UVA Project, 1980.

B. MISSION COMPONENTS

- R. Fitz, J. Troha, and L. Wallick, An Integration of Normative Models for Environmental Education, Univ. of Dayton, Ohio, Report on Contract 300-700-4029, June, 1978.
- A Sourcebook for the Design of Regional Environmental Learning Systems, Volume 2, You Create a Design, UVA Project, 1980, Chapter 1.

C. LEARNING SYSTEM DESIGN DIMENSIONS

- A Sourcebook for the Design of Regional Environmental Learning Systems, Volume 2, You Create a Design, UVA Project, 1980, Chapter 3 and Appendix

D. DESIGN OPTIONS

- Same reference as for Learning System Design Dimensions

E. COMPONENTS OF CONTENT

- The Environmental Education Act of 1970, as amended (P. L. No. 91-516, 93-278, 95-482)
- A Sourcebook for the Design of Regional Environmental Learning Systems, Volume 6, Content-Oriented Resources, UVA Project, 1980.

F. FOCUSING CONTEXTS

- Environment-Based Environmental Education, Arizona State University, Contract No. OEC-74-8739, June 30, 1979.

G. FACILITATING PROCESSES

- A Sourcebook for the Design of Regional Environmental Learning Systems, Volume 4, Conducting Collective Inquiry, UVA Project, 1980.

H. TYPES OF RELATIONS

- Self-Paced Learning Unit, Relation Needs for Environmental Education, UVA Project, 1980.

I. TYPES OF ACTIVITIES

- R. Fitz, J. Troha, and L. Wallick, An Integration of Normative Models for Environmental Education, University of Dayton, Ohio, Report on Contract 300-700-4029, June, 1978.
- A Sourcebook for the Design of Regional Environmental Learning Systems, Volume 1, Overview, UVA Project, 1980, Chapter 4.

J. DECISION-MAKING LEVELS

- B. H. Banathy, S R. Mills, and C. E. Aaron, The Institutionalization of Environmental Education in the Formal Education Sector, Far West Laboratory for Educational R&D, Grant No. G007802598, September, 1979.
- R. H. Atkin, Combinatorial Connectivities in Social Systems, Birkhauser Publ., Basel and Stuttgart, 1977.

K. DECISION AREAS

- J. N. Warfield, "A Role for Values in Educational System Design," Proc. International Conference on Cybernetics and Society, IEEE, New York, October, 1980 (see Appendix to this report).

M. SYSTEM ROLES

- *Federal Programs Supporting Educational Change*, RAND Report, R-1589-HEW, Volume VIII, Santa Monica, CA, 1978.
- *A Conceptual Basis for the Design of a Regional Environmental Learning System*, UVA Project Report, 5th Quarterly Report, January, 1979.

N. CONSTRAINTS

- J. N. Warfield, *Societal Systems: Planning, Policy, and Complexity*, Wiley, New York, 1976, Chapter 3.
- J. Piaget, *To Understand is to Invent*, Grossman, New York, 1973.

CHAPTER 4

RESOURCES FOR ENVIRONMENTAL EDUCATION

INTRODUCTION

To this point in the report, we have developed the requirements for environmental education, introduced a number of sets of elements that bear on these requirements, offered organizing models for environmental education, and shown how various roles can relate to the models.

The purpose of this chapter is to bring together in one diagram the connection of the various models to specific resources for environmental education. In this way, the interested reader can look in one place for reference to those materials resources that relate to the models. This presentation will supplement the references given in Chapter 3, which showed how the sets that are connected through the models relate to specific references.

TYPES AND ORIGINS OF RESOURCES

It is not our purpose here to replicate what is readily available in libraries. Instead we limit our resource reference to reports and self-paced learning units. The reports referenced are primarily those developed in two large projects sponsored by the Office of Environmental Education. The self-paced learning units also were developed in a project sponsored by the Office.

Reports were developed either by the Far West Laboratory for Educational Research and Development, or by the University of Virginia Consortium identified in Chapter 1. Self-paced learning units were developed by the University of Virginia Consortium.

IDENTIFICATION OF RESOURCES

In this chapter, the resources are identified by title and by a code consisting of a letter, number, or combination. More complete descriptions of the reports appear in the Appendix to this report titled Abstracts of Environmental Education Program Design Resources.

At the time of writing of this report, all of the reports identified in this chapter have been written. However only part of the self-paced learning units have been written in first draft. Those that have been completed in first draft appear in Volume 2, and are identified by asterisks in Table 4. It is hoped that eventually all the units can be developed.

It is expected that reports and units can be obtained through the Office of Environmental Education or, for some of the material, through the ERIC information system. A principal depository for environmental education materials in the ERIC system is located at The Ohio State University, Columbus, Ohio, 43210.

Table 4 lists the self-paced learning materials by title, along with the numerical code. Table 5 lists the reports along with identifying letters or letter/number combinations.

TABLE 4

IDENTIFICATION OF SELF-FACED LEARNING UNITS

1. Self-Paced Learning Units for Environmental Education
2. Hierarchical Levels in the Education System
*3. The Perry Educational Philosophy
*4. The EE Act of 1970 (as amended)
*5. Implications of Developmental Theory for Curriculum Design
*6A. Relevance of Perry Philosophy for Environmental Education
*7. Identifying Environmental Education
*8. Merging Content and Context with Process, Emphasizing Relations
9. Formal and Informal Sector Interactions in Environmental Education
*10. Materials Needs for Environmental Education
11. Institutional Concerns for Environmental Education
*12. Relation Needs for Environmental Education
*13. Context Needs for Environmental Education
*14. Content Needs for Environmental Education
15. Process Needs for Environmental Education
16. Six Action Components for Environmental Education
*17A. Reading Maps of Relations
18. Mission for Environmental Education
19. NOT USED
20. Three Methods for Generating Elements

TABLE 4 (CONTINUED)

21. The Big Map of Environmental Education
22. Themes and Issues in Environmental Education
23. Selecting a Structuring Relation
24. A Regional Environmental Learning System
25. The Energy Theme
*26. The Human Settlements Theme
*27. Methods of Collective Inquiry
28. Roles Needed in Environmental Education
29. Case Studies in Collective Inquiry
30. System Design Role in Environmental Education
31. Organizer/Broker Role in Environmental Education
*32. Facilitator Role in Environmental Education
33. Computer Role in Environmental Education
34. Technician Role in Environmental Education
35. Designing a Regional Environmental Learning System
36. Levels of Facilitator Capability
37. The Comprehensive Environmental Education Project
38. Preparing for Environmental Education
39. Strategy for Organizing for Environmental Education
40. Tactics for Implementing Environmental Education
41. Special Classroom Arrangements for Environmental Education
42. Special Informal Arrangements for Environmental Education

TABLE 5

IDENTIFICATION OF REPORTS

A. Moving Ahead in Environmental Education

B. Designs for the Future of Environmental Education

C. Descriptive Analysis of Environmental Education

D. An Integration of Normative Models for Environmental Education

E. Learner Readiness for Environmental Education

F. Conceptual Basis for the Design of a Regional Environmental Learning System (RELS)

G. Sourcebook for the Design of Regional Environmental Learning Systems (RELS)

    G1. Overview

    G2. You Create a Design

    G3. Creating a Regional Environmental Learning System

    G4. Conducting Collective Inquiry

    G5. Evaluating a Regional Environmental Learning System

    G6. Content-Oriented Resources

H. A Partial History of the Environmental Education Act

I. Abstracts of Grant Products

J. FWL Teacher Training Models

    J1. Orientation

    J2. Content Specifications

    J3. Curriculum Management Specifications

    J4. Implementation

TABLE 5 (CONTINUED)

K. FWL Content Sourcebook

L. FWL Energy-Focused Environmental Education Teacher Training Units

M. FWL The Institutionalization of Environmental Education in the Formal Education Sector, a Generic Model

N. FWL The Design of Environmental Education Delivery Systems, A Procedural Guide

P. ASU-NAG Environment-Based Environmental Education: Inventory, Analysis, and Recommendations

Figure 12, An Index to Environmental Education Resources, connects the resources to the models. A solid arrow on the graphic means that the material lying below *is included in* what is above. Dashed lines on the graphic mean that the material lying below *is relevant to* what is above.

Square rectangles on the graphic containing symbols like U5, U6, G1, etc., indicate *primary* reference sources relevant to what lies above. The code U5 would refer to self-paced unit number 5, while the code G1 would refer to the Overview volume in the Sourcebook for the Design of a Regional Environmental Learning System, as indicated in Table 5.

The reader may, if desired, begin with a knowledge of the general characteristics of roles and models and, starting with Figure 11, determine what models are relevant to a particular role. Then, armed with a list of relevant models, go to Figure 12 and see which documents are the primary resources germane to the role and which other references are relevant to that role. In this way, one can generate a self-selected

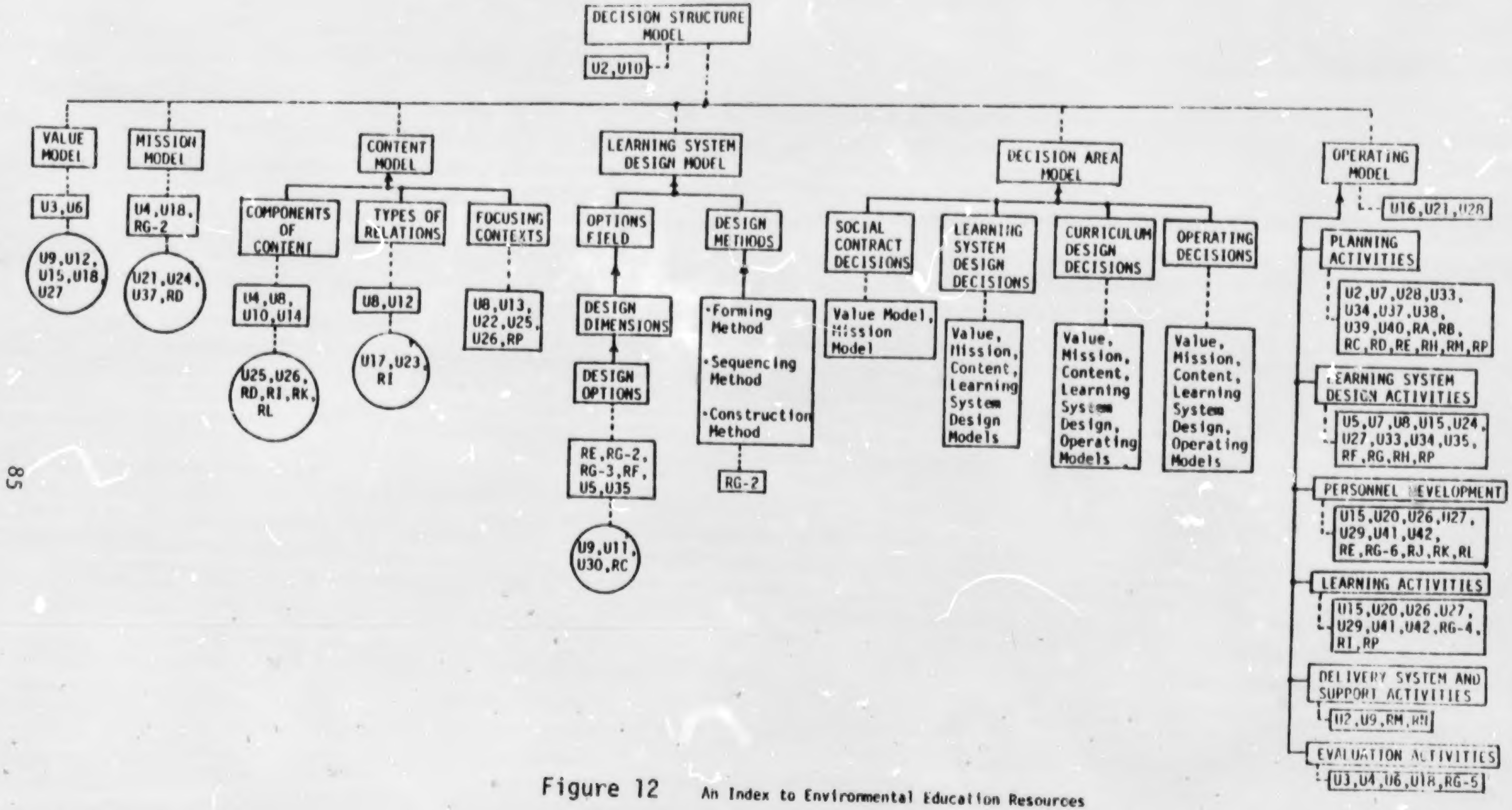

DECISION STRUCTURE MODEL
U2,U10
VALUE MODEL
U3,U6
U9,U12,
U15,U18
U27
MISSION MODEL
U4,U18,
RG-2
U21,U24,
U37,RD
CONTENT MODEL
COMPONENTS OF CONTENT
U4,U8,
U10,U14
U25,U26,
RD,RI,RK,
RL
TYPES OF RELATIONS
U8,U12
U17,U23,
RI
FOCUSING CONTEXTS
U8,U13,
U22,U25,
U26,RP
LEARNING SYSTEM DESIGN MODEL
OPTIONS FIELD
DESIGN DIMENSIONS
DESIGN OPTIONS
RE,RG-2,
RG-3,RF,
U5,U35
U9,U11,
U30,RC
DESIGN METHODS
·Forming Method
·Sequencing Method
·Construction Method
RG-2
DECISION AREA MODEL
SOCIAL CONTRACT DECISIONS
Value Model, Mission Model
LEARNING SYSTEM DESIGN DECISIONS
Value, Mission, Content, Learning System Design Models
CURRICULUM DESIGN DECISIONS
Value, Mission, Content, Learning System Design, Operating Models
OPERATING DECISIONS
Value, Mission, Content, Learning System Design, Operating Models
OPERATING MODEL
U16,U21,U28
PLANNING ACTIVITIES
U2,U7,U28,U33,
U34,U37,U38,
U39,U40,RA,RB,
RC,RD,RE,RH,RM,RP
LEARNING SYSTEM DESIGN ACTIVITIES
U5,U7,U8,U15,U24,
U27,U33,U34,U35,
RF,RG,RH,RP
PERSONNEL DEVELOPMENT
U15,U20,U26,U27,
U29,U41,U42,
RE,RG-6,RJ,RK,RL
LEARNING ACTIVITIES
U15,U20,U26,U27,
U29,U41,U42,RG-4,
RI,RP
DELIVERY SYSTEM AND SUPPORT ACTIVITIES
U2,U9,RM,RN
EVALUATION ACTIVITIES
U3,U4,U6,U18,RG-5

Figure 12 An Index to Environmental Education Resources

reading list through which familiarity with role requirements or concepts can be achieved through self study. The role of providing Technical Assistance will be burdened with becoming familiar with all of the models; and thus is a very stringent role in working toward the growth of environmental education.

CHAPTER 5

APPROACH TO EVALUATION

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If the Regional Environmental Learning System approach is tried, there will be a need to consider its evaluation. Evaluation is judged to be necessary for two primary reasons:

- The allocation of funds for education often is based upon the results of evaluation
- The improvement of past practice relies on judgments about those practices that can help provide a basis for introducing change

While there are many views and many methods of evaluation, this does not assure that good evaluation will be done for a RELS or that any basis for consensus can be found. Therefore we present here a rather self-contained approach to evaluation of a RELS.

THE LOGIC OF EVALUATION

The logic of evaluation can be introduced through a set of five purposes of evaluation. Let P represent what is to be evaluated. Then the purposes can be expressed as follows:

- To know what happens in P
- To interpret what happens in P in relation to an understanding of the purpose of P
- To compare what is happening in P with what has happened in the past with P' or what is happening in the present in P" or both

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- To fix belief concerning the worth of P, selectively by components if possible, and in an overall sense,
  - -- in relation to the external surroundings of P
  - -- in relation to the internal functioning of P
- To project an improved successor P_s to P, with adequate rationale based on understanding of P

To achieve these purposes, it is inevitable that a description of P will be developed, and that an analysis of P will be carried out. The description and analysis will be based on observation and data collection.

If, as is often true, P is finite in duration, but its purpose and potential impact extend well into the time period beyond the finite duration of P, it is evident that observation and analysis of P alone are not sufficient to fix belief concerning the worth of P in relation to the external surroundings (which persist after P is complete).

If, as is often true, P is continuous in time and is spread out in space, it will normally be impossible to maintain total and continuous observation of P. Thus observations are necessarily of a sampling nature.

If, as is often true, it is not feasible to collect all of the data that could conceivably be collected given infinite resources and access to P, selectivity in the choice of data to be collected is required. Criteria are therefore required to guide the selectivity.

Likewise, criteria are required for deciding what to observe and when to observe it.

THREE MAJOR CONCERNS WITH EVALUATION

Three major concerns need to be thought about in relation to evaluation. These are:

- Misleading results due to the Hawthorne effect
- The possible impact of the evaluation activity on the happenings in P
- The immaturity of evaluation methodology

The Hawthorne Effect. It is well-known that whenever people are involved in a deliberate change of some kind, their reaction to the change may be affected not only by the specific nature of the change, but by the mere fact that change or novelty is present. Results of an evaluation invariably are less credible when this effect is present.

The Possible Impact of the Evaluation Activity on the Happenings in P. Measurement is seldom disjoint from what is measured. Thus measurement often modifies P, so that what is measured differs from what would occur in the absence of measurement.

The Immaturity of Evaluation Methodology. Evaluation methodology is immature, and is likely to remain so for some time. As a kind of adjunct to social science, evaluation methodology is like social science in general, in that it is evolving and, hopefully, is self-correcting through time as the results of evaluation experiences accumulate and are subjected to appraisal by the scientific community.

EVALUATION RECOMMENDATIONS

In the light of, and tempered by, the foregoing comments, we recommend that a RELS or a Comprehensive Project aiming at serving as a pilot test or demonstration project in moving toward a RELS be evaluated along the following lines.

PART 1. Evaluation of the RELS Design.

The utility of any evaluation depends on an understanding of the referent for the evaluation. What is being evaluated is a RELS or its early manifestation. Since every RELS will be different, being locally designed, the evaluation of any one of them cannot be used to relate with to others unless one can understand the system to which the evaluation refers.

Evaluation of the RELS design can be based on the Options Field and the process suggested for using this device participatively to obtain a decision and, at the same time, to generate common understandings concerning the kind of system that will be implemented.

Questions such as the following may be considered:

a. Was the Options Field used to facilitate the design of the RELS? If not, what was?

b. Were the interdependencies among dimensions explored enroute to a design?

c. Was the design documented? Was the documentation made available as a learning aid to persons who would be involved in the RELS but who were not part of the design process?

d. Is the documentation adequate to inform persons in other locations, who might wish to learn from the experience of others?

e. What appear to be the strengths and weaknesses of the design?

PART 2. Evaluation of the RELS Coherency.

Closely connected to an evaluation of the RELS design will be an evaluation of whether the RELS, in operation, enjoys coherency. Coherency can be evaluated with the aid of several of the organizing models. For example, these matters may be considered:

a. Does the RELS include the six operating components identified in the Operating Model? Of what do they consist? Are these components interacting to reinforce each other?

b. How does what is happening in the RELS correlate with the requirements of environmental education as envisaged in the Implication Model? Are there any gaps?

c. Is there clear role identification in the RELS? How do the roles compare with those identified in the Set of Roles? Are the roles interacting to reinforce each other?

d. How does the Decision Area Model relate to the RELS? What major decisions are being made? Are they being correlated as indicated in the Decision Area Model?

e. Can representatives of the six levels in the Decision Structure Model be seen as active in the RELS? How are these six levels interacting?

f. Does the RELS appear, in general, to be a coherent system, or is it operating as a set of disconnected activities?

PART 3. Evaluation of the Learning Experience.

While one is primarily interested in the learning that goes on in an educational system, measurement of what is learned is most meaningful when it can be interpreted in the learning context. Thus evaluation of the learning experience should include, in addition to measurement of what was learned, assessment of the learning materials and processes, and of the learning context. Such questions as the following may be considered:

a. Was a specific context prominent (such as human settlements) as an encompassing framework for the learning?

b. How did the content being learned correlate with the Content Model for environmental education? What components were included? Was attention to the components evenly balanced? Or was there very strong emphasis on one component to the exclusion of others?

c. Were specific relations identified, whereby the components of content were interrelated? Or were the relationships suppressed in deference, for example, to simply developing awareness of the environment?

d. Was quantification stressed to the detriment of insight?

e. Were local or regional plans introduced to provide concrete examples to which the learner can relate? Were community or regional resource persons involved in clarifying conditions in the human settlements for the learners? Or was the learning experience exclusively academic in nature?

f. How were the demonstrated cognitive limitations on human beings in learning relations among a large number of related elements of the environment dealt with? Were they suppressed, ignored, or denied? Were they recognized, and did the learning strategy provide explicitly for overcoming these?

g. What materials resources were used? Can these be assessed against alternatives that might have been used? Were materials related to the Content Model? Were there significant gaps in materials?

h. Did the examinations used to test the learning reflect attention to some of the learning outcomes in the Mission Model? Did they reflect, in some way, the values in the Value Model?

i. Given the relatively short experience with environmental education, is it possible to zero in on specific learning objectives measurable at the Learning Experience level in the Decision Structure Model that would fairly represent achievement in environmental education?

j. If control groups were used, how well did the experimental and control groups compare in terms of achievement? What is the significance of the comparison?

k. What did the teachers think of the learning processes used? What were the strengths and weaknesses of the processes?

l. Which of the experiences is likely to result in permanent adoption in the educational system? Why? Which of the experiences is probably going to be cast aside in the future? Why?

To conclude the recommendations, we recommend that the methodology used to do the evaluation be documented. This will help readers make judgments about the evaluation results. Often it is necessary to try to decide whether some outcome of an evaluation is a consequence of the evaluation methodology, a consequence of the way in which the system was designed, a consequence of the specific mode of implementation, or a consequence of other factors that may not have been included in the evaluation. By clarifying the evaluation methodology, its impact can be assessed somewhat independently of the other factors mentioned.

CHAPTER 6

SUMMARY RECOMMENDATIONS

THE COMPREHENSIVE PROJECT

The noted philosopher, C. S. Peirce, identified two types of philosophers: "seminary philosophers" and "laboratory philosophers." If the approach to environmental education outlined in this report appears worthy of further development, perhaps it is appropriate to deal with it from the point of view of laboratory philosophy. Viewed in this way, all of the sets, models, roles and materials can be perceived as a hypothesis awaiting testing; as opposed to a seminarial pronouncement awaiting implementation.

Our recommendation in this respect is as follows:

- Frame a comprehensive project that is sufficiently large to be representative of a Regional Environmental Learning System that the hypothesis can be tested; but one which is no larger than that.

  Bend every effort to make the project a success, but treat it also as an experiment from which learning can take place to test the sets, models, roles, and materials. Use that learning which accrues to improve the hypothesis and to particularize it to the locale or region.

THE REGIONAL ENVIRONMENTAL LEARNING SYSTEM

Our previous recommendation that environmental education be conceived through the idea of Regional Environmental Learning Systems (RELS), embodying local design, and relying on roles locally developed, is in response to a variety of needs that we perceive in education in general as well as a response to the stringent requirements of environmental education.

Our recommendations concerning the RELS are as follows:

- Be sensitive to the importance of role definition, so that needed but new roles can be identified, defined, and harmonized with a set of system roles.
- Test the concept of RELS through a comprehensive project, and if the results are favorable, move ahead with enhanced size, scope, and effort.
- In decision making, be sensitive to the values of American education, and to the practical needs of persons who must gain individual status in order to advance this field. Agreement on a context and content, with continuing attention to steady evolution of content, will help to achieve this recommendation.
- Give due attention to what research has shown about human development and learning, and reconcile human cognitive limitations with the style of learning that is used for environmental education.

POSTURE TOWARD ENVIRONMENTAL EDUCATION

Advances in environmental education will depend heavily upon the posture taken by those who feel that environmental education should become a larger, more important part of the educational experience.

Our recommendation in this respect is as follows:

- Suspend judgment on the work reported herein until there has been opportunity to become familiar with it in sufficient detail that the interconnections developed herein are clarified. Be neither an advocate nor an opponent until the work is understood. Do not rely only on what is presented in this report. Where there are questions, dig deeper into the references (using Figure 9) and reflect on what is said.

RECOMMENDATIONS FOR FUTURE RESEARCH

The following recommendations for future research are limited to those that we perceive to be appropriate for sponsorship by the Office of Environmental Education, under the provisions of the Environmental Education Act.

Recommendation 1. Design of Technical Assistance Programs.

We believe that extensive and well-coordinated technical assistance programs are needed, and that they must be given the highest priority if the potential for significant progress in implementing and institutionalizing environmental education is to be realized.

The technical assistance provided must be substantive, phased, and of sufficient duration to assure that the needs it is intended to serve are met. It should increase the long-term program design capabilities of those being assisted as well as provide technical guidance in the specific design and implementation task being undertaken.

The technical assistance programs need to be designed. Among other things, the design activity should consider alternatives for organizing and phasing the use of the various resources that are now available and determine productive and cost-effective modes of use.

Because of the substantive requirements for design and implementation of interdisciplinary EE programs, the technical assistance design activity should also consider ways to facilitate individual review and study that will be needed prior to and in conjunction with "institutes" or "workshops" for group assessment and study of needs, resources and options. In this regard, some preliminary work on self-paced learning units has been undertaken. While we are not completely satisfied with the units developed, we believe that the concept is sound: to prepare small units, each of which addresses in isolation and in reasonable depth one key question that is covered comprehensively in other available resources.

Finally, a "practicum" component will be needed to provide guidance in the design of site-specific programs and training in interdisciplinary program design and implementation.

Recommendation 2. Evaluation of RELS-like activities.

We suspect that there will be several RELS-like activities in the next few years. Attention should be given to the evaluation needs of these activities *before* the fact. The recommendations made in this report concerning evaluation highlight the fundamental, critical needs in this area but they do not constitute a design or plan. At minimum, a generic evaluation design should be developed based on these recommendations. Ideally, a specific design should be developed that assures a high degree of consistency in terms of application and results, while maintaining the flexibility required for accuracy and utility of the results.

APPENDIX I

ABSTRACTS
OF
ENVIRONMENTAL EDUCATION
PROGRAM DESIGN RESOURCES

AN INTRODUCTION TO

ENVIRONMENTAL EDUCATION RESOURCES

The University of Virginia Center for Participative System Design, supported by the U. S. Office of Environmental Education, and assisted by several subcontractors, developed a set of environmental education resources. The design and development of these resources were based on a conception of environmental education that is consistent with the Environmental Education Act of 1970 (P. L. 91-516, and subsequent amendments, including P. L. 93-278 and P. L. 95-561), namely that environmental education should:

- focus on and clarify the complex relationships existing between natural and human systems, and examine the many aspects and interdependencies of both;
- use information from a variety of fields and disciplines (including the natural sciences, social sciences, and humanities) in order to deal adequately with the ecological, social, aesthetic, economic, technological and cultural dimensions of environmental issues; and
- emphasize problem-solving and decision-making by presenting real environmental problems or issues that have local, regional, national, or global significance. It should engage learners in values clarification, problem-solving, planning, and decision-making activities that prepare them for dealing with environmental problems and issues that affect individuals and society.

THE TYPES OF RESOURCES

Resources are of several types, suitable for various target audiences. They range from resources for strategic planning for environmental education to mathematics problems suitable for eighth-grade classes.

THE RESOURCES

A. Moving Ahead in Environmental Education

This essay discusses the future of environmental education in a philosophical vein and suggests design approaches for the future of environmental education.

B. Designs for the Future of Environmental Education

This is the final, summary report on the UVA Project. It organizes the results of the study, and connects other project reports to specific topical areas. Some self-paced learning materials are included to provide depth in selected areas.

C. Descriptive Analysis of Environmental Education

This project report presents a basis for a descriptive analysis of environmental education, distinguishes formal and informal environmental education, assesses compatible and mutually supporting roles for formal and non-formal environmental education, compares environmental education with a normative model (see), and discusses some strategies for change.

This report is primarily for general audiences with other reports furnishing more detail.

D. An Integration of Normative Models For Environmental Education

This project report synthesizes a structure for environmental education consisting of seven major parts: planning, learning systems design, personnel development, learning activities, delivery systems and support, evaluation and learning outcomes. Each of these parts is structured in detail, to furnish an integrated map of environmental education.

The sources of the map elements are given, and the method of developing the map is explained.

This report should be useful to persons who want to see an overall organizational framework for environmental education.

E. Learner Readiness for Environmental Education

This report, developed under a subcontract to the Far West Laboratory for Educational R&D, reviews the current status of learning and developmental theory, and the connection of this work to curriculum design. The implications of the present state of knowledge for the conduct of environmental education are given.

This report should be valuable to persons concerned with personnel development, curriculum development, and learning system design.

F. Conceptual Basis for the Design of Regional Environmental Learning Systems (RELS)

This report is intended as a thought piece to help illuminate the idea of a "Regional Environmental Learning System." The RELS concept offers a model for how to think about developing environmental education through local initiative.

While this report is oriented toward the general reader, in its later chapters it begins to focus upon learning systems design.

G. Sourcebook for the Design of Regional Environmental Learning Systems (RELS)

This is a report in six volumes. Building on the work reported in C, D, E, and F, which is presumed to have been studied as background, these volumes offer ideas, methods and initial models for local design and implementation of a RELS.

- Volume 1. Overview

  The Overview volume places the Sourcebook in focus, describes the contents of succeeding volumes, discusses major issues in environmental education and proposes responses to them, presents a pyramidal set of definitions of environmental education ranging from a "popularized" definition to an elaborate definition set forth in D, and outlines approaches and strategies for carrying out environmental education.

- Volume 2. You Create a Design

  This volume develops in detail a mission for environmental education, explores the design of a learning system from a political perspective, discusses how conceptual system design can be carried out, and discusses the relation of projects to the Environmental Education Act of 1970.

  The important role of facilitator in learning systems design is described in the Appendix.

  This volume is intended for use by education innovators.

- Volume 3. Creating a Regional Environmental Learning System

  This volume addresses the networking aspects of learning system design, with particular application to informal environmental education. It also is relevant to establishing good linkages between formal and informal environmental education.

- Volume 4. Conducting Collective Inquiry

  This volume explores alternative ways of conducting environmental education through an inquiry mode. The inquiry mode of learning is thought to have the greatest promise for environmental education, because of the need to learn through information sharing. Several tested means for conducting collective inquiry are described. Appendices contain full descriptions of computer software that can be used to help facilitate the organization of complex issues. With the aid of a skilled facilitator, this software can be a major aid in learning, as has been demonstrated in numerous settings, including high school.

- Volume 5. Evaluating a Regional Environmental Learning System

  This volume is primarily for persons who are novices in evaluation, but who are interested in seeing that evaluation gets done. Various cases are given as examples for focusing and illustrating evaluation ideas and philosophies. Numerous techniques and methods for evaluation are set forth, possible resource persons are identified, and a bibliography is given.

- Volume 6. Content-Oriented Resources

  Two different kinds of problem sets are offered for use in the eighth grade mathematics curriculum. These stress environmental issues, and range from very simple problems in arithmetic to more sophisticated structuring problems.

  The use of collective inquiry methods is developed in the context of a thematic approach to the study of human settlements. The materials shown here are illustrative of how environmental education can be developed thematically in the formal system, as a way of preparing persons for effective citizenship in their communities.

H. A Partial History of the Environmental Education Act

This report is a collection of items relating to the history of the Environmental Education Act of 1970. It is thought that this partial history will be of interest to persons who are seeking an understanding of the federal role in environmental education, and a feeling for how the Environmental Education Act has influenced environmental education.

I. Abstracts of Grant Products

Over 700 projects were sponsored under the Environmental Education Act during the years 1971-77. Nine reports contain material aimed at abstracting the results of these projects. The contents of the several reports are as follows:

- 1977 Grant Materials Descriptions
- 1976 Grant Materials Descriptions
- 1975 Grant Materials Descriptions
- 1974 Grant Materials Descriptions
- 1973 Grant Materials Descriptions
- 1972 Grant Materials Descriptions
- Additional 1972 Grant Materials Descriptions and 1971 Grant Materials Descriptions
- Audio-Visual Materials Descriptions
- Regional Materials Analyses for 1971-76

These abstracts should be of most interest to teachers or project directors, but because of the passage of time, probably the most useful volumes would be those providing the 1977 grant materials descriptions and the regional materials analyses.

Information on the availability of these materials can be obtained by contacting:

Mr. Walter Bogan, Director
Office of Environmental Education
Room 1100
Donohoe Building
400 6th Street S. W.
Washington, D. C. 20202
(Phone: 202-245-9231)

AN INTRODUCTION TO ENVIRONMENTAL EDUCATION TEACHER TRAINING RESOURCES

The Far West Laboratory for Educational Research and Development, supported by the U. S. Office of Environmental Education, developed a set of teacher training models, a sourcebook, and a series of units for environmental education with an energy focus. The design and development of these teacher training resources were based on a conception of environmental education that is consistent with the Environmental Education Act of 1970 (P. L. 91-516, as amended by P. L. 93-278 and P. L. 95-561), namely that environmental education:

- should focus on and clarify the complex relationships existing between natural and human systems, and examine the many aspects and interdependencies of both;
- should utilize information from a variety of fields and disciplines (including the natural sciences, social sciences and humanities) in order to deal adequately with the ecological, social, aesthetic, economic, technological, cultural and ethical dimensions of environmental issues; and
- should emphasize problem-solving and decision-making by presenting real environmental problems or issues that have local, regional, national or global significance. It should engage learners in values clarification, problem-solving, planning, and decision-making activities that prepare them for dealing with environmental problems and issues that affect individuals and society.

THE ENVIRONMENTAL EDUCATION TEACHER TRAINING MODELS

The teacher training models describe the various dimensions and priorities of environmental education teacher training programs and specify general content and methods for conducting such programs.

Each of the four Environmental Education Teacher Training Models is targeted to a different group of educators: high school teachers, natural science teachers (grades K-9), social science teachers (grades 4-12), and community leaders (in environmental education).

The models provide specifications for energy-focused environmental education (EE) programs and training materials which: (1) develop teachers' and community educators' understanding of EE, and (2) develop their professional capabilities in devising instructional/learning arrangements that communicate this understanding to others.

Each model contains both generic and specific information presented as follows:

- An ORIENTATION section that describes the rationale and definition of environmental education and specifies teacher training objectives.
- CONTENT SPECIFICATIONS section that indicates model relevant curriculum content areas for teacher training/community leadership and provide annotated bibliographies of resource materials that transmit this content.

- A CURRICULUM MANAGEMENT SPECIFICATIONS section that presents general instructional arrangements by which teachers can purpose, plan, implement and evaluate environmental education activities for students (High School model).
- An IMPLEMENTATION section that presents an overview of the basic characteristics and functions of a teacher training system (High School model and Community Leadership model).

THE CONTENT SOURCEBOOK

The Content Sourcebook presents an elaborated and annotated discussion of the teacher training curriculum content presented in the models and is intended to provide a more detailed understanding of the resources needed to develop comprehensive environmental education curricula.

The *Sourcebook* elaborates on the following curriculum content areas: a systems approach; problem-solving and decision-making; energy/environmental career-related decisions; holistic lifestyle assessment; ideal environmental world views; fundamental concepts of energy; energy resource delivery systems; forecasting, planning and policy formation; and futures thinking.

The *Sourcebook* also (1) describes applications of the EE training models for their intended users and the components of an EE curriculum; (2) presents 12 key concept/topic areas interpreted from the EE Act of 1970; (3) introduces narrative descriptions of ten major energy or environmental issues that can provide the basis for the development of EE curricula; and (4) provides a structure for thinking about EE curricula content in terms of: (a) EE principles and concepts; (b) instructional learning resources; and (c) competencies (for the environmentally aware and literate citizen) for each of the curriculum content areas described in the previous paragraph.

Finally, the *Sourcebook* provides a BIBLIOGRAPHY and GLOSSARY for each of the curriculum content areas.

THE ENERGY-FOCUSED ENVIRONMENTAL EDUCATION TEACHER TRAINING UNITS

The teacher training units are designed specifically for use in secondary level preservice or inservice training, but can also be used in continuing education programs and by small groups of teachers at any grade level who wish to increase their understanding of energy and environmental issues and their competence in dealing with such issues in their classrooms.

The four units or "modules" comprise a series or basic set of introductory materials consistent with the need described in the EE Act. Although the units were derived from the High School Teacher Training Model--mentioned previously--field try-outs have indicated their general usefulness to teachers at any grade level (as well as to student teachers). The units provide content, activities, and designate resources that help foster in teachers an understanding of our natural- and human-fashioned environment and for presenting this understanding in the context of energy-focused environmental issues. The units or modules enable teachers to develop their environmental awareness by exploring issues involving interactions between the systems of humanity and nature. The issue focused content of the training units is described below:

- OPTIMAL USE OF FINITE LAND RESOURCES
Teachers examine finite land resources, population dynamics, and available energies that must be in dynamic equilibrium in order to maintain a stable balance between the needs of urban and agricultural systems as they develop and grow, and needs of the natural systems to maintain their ecological integrity.

- ENERGY-INTENSIVE URBAN GROWTH AND THE QUALITY OF LIFE
Teachers examine the pattern of U. S. urban growth as influenced by economic, social, political, and ecological considerations for enhancing the quality of life. They examine the potential of current urbanization to reverse its present trend toward high energy costs with decreasing quality of life for urban society. They also examine the implications of envisioned future patterns of urbanization on energy costs and the quality of life.

- ENERGY-CONSERVING RESOURCE UTILIZATION
Teachers compare a variety of energy conservation strategies and their contributions in terms of a stewardship approach to resource utilization and conservation. They analyze the conservation recommendations of the National Energy Plan and act as a special task force to propose conservation measures for a local community.

- ENERGY RESOURCE DELIVERY AND USE
Teachers examine the role of energy in changing cultural contexts. They study the nature and uses of various conventional and nonconventional energy resources, examine the dimensions of energy policy making, and evaluate the implications of differing means of energy delivery in terms of their technical efficiency, and environmental and social impacts. They also evaluate an energy policy plan.

Each training unit or "module" follows a similar presentation format:

- An INQUIRY section that presents the facts, concepts, and principles associated with an energy-environmental issue. This section includes text, readings, and activities.

- An INTEGRATION section that presents a planning and decision-making activity or simulation involving the issue in a practical setting.

- An APPLICATION section that presents general guidelines for planning and implementing instruction units emphasizing the issue.

For further information on any of these documents or materials, write to:

Bela H. Banathy
Executive Research Director
Far West Laboratory for Educational
Research and Development
1855 Folsom Street
San Francisco, California 94103

For ordering materials, write to:

National Teaching Systems
1137 Broadway
Seaside, California 93955

PRICE LIST:

EE Teacher Training Model for:

High School Teachers	$ 6.00
Natural Science Teachers	6.00
Social Science Teachers	6.00
Community Leaders	6.00

EE Content Sourcebook	12.00

Energy-Focused EE Teacher Training Unit on:

Optimal Use of Finite Land Resources	8.00
Energy Intensive Urban Growth and Quality of Life	8.00
Energy-Conserving Resource Utilization	8.00
Energy Resource Delivery Use	8.00

NATIONAL TEACHING SYSTEMS was formed nearly a decade ago, by a group of educators. It specializes in publication and marketing of advanced educational systems and ideas with a limited but specific sales potential. This ability provides an ideal service for educational research organizations such as Far West Laboratory for Educational Research and Development whose products may not address a large enough market to generate commercial appeal, yet provide a vital resource for the educational community.

APPENDIX 2

SYSTEMS PLANNING FOR ENVIRONMENTAL EDUCATION

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APPENDIX 3

A ROLE FOR VALUES IN EDUCATIONAL SYSTEM DESIGN

A ROLE FOR VALUES IN EDUCATIONAL SYSTEM DESIGN+

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ABSTRACT

A common complaint in social system research and design is that values are not made explicit. In designing an educational system for carrying out environmental education, it is possible to make explicit values that bear on decisions. To achieve this, the educational system is represented by a set of structural models, several of which require reference to values. One model identifies decisionmaking levels in the education system and another identifies major types of decisions relative to environmental education.

A consistent set of values is introduced directly from the educational philosophy of Ralph Barton Perry. The use of values from a professional philosopher helps assure that an educational system design is consistent with long-term concerns and that designer bias is minimized. Also the quality of expression of values is enhanced because of the scholarly orientation from philosophy.

INTRODUCTION

Underlying any system design there is an implied basis in values. A common complaint in social system research and design (and in other design areas to a lesser extent) is that values are not made explicit, nor are they related to design decisions in a way that makes the connections evident. The reasons for the presumed discrepancies are not clear. A variety of explanations can be given, none of which is conclusive. One possible explanation is simply that methodology is deficient. Fortunately it is not necessary to prove this assertion before undertaking to develop relevant methodology. In the absence of suitable methodology, there is no way to prove it. The only true test is to develop methodology and then observe its impact, if any.

Educational system design is a particularly good area in which to try to couple values explicitly with system design. There is no question of the relevance of values to education, but only a question of what values applied in what way to what kinds of decisions might yield what kinds of consequences.

Within education, environmental education is an excellent area to test the utility of system design based in explicit values. Environmental education is inherently interdisciplinary, and this alone creates many difficulties in system design. One can argue that as the number of inherent difficulties in design grows the role of an explicit value base against which design decisions can be referenced is even more important than in less onerous situations.

We approach the educational system design problem with a perspective in which environmental education is viewed as one part of the larger educational endeavor. Because environmental education is interdisciplinary, and because it is somewhat controversial, we spend considerable effort in structuring it before proceeding to introduce values.

We begin by listing nine structural models that have roles to play in a consideration of the design of educational systems in which environmental education might become prominent. The first of these models to be discussed is called an "implication model". It is intended to suggest what the requirements might be for environmental education to flourish, and how a set of three primary requirements appears to imply a number of secondary requirements. This model provides the background against which the remainder of the discussion can be viewed.

The second model to be discussed is an integrating model that shows how the remaining seven models relate.

We then focus on the development of three of the models into a framework for values analysis, and show how this organizing framework can be conceived in terms of the requirements for environmental education. The connection of the framework to system design and operation is then discussed.

Our principal conclusion is that environmental education can be institutionalized successfully. To achieve this goal, personnel development and materials development are required, and field demonstrations that incorporate sound designs are necessary. But underlying these activities there must be a sound value base, developed along the lines discussed herein, otherwise environmental education will not become a significant component of the American educational system.

STRUCTURAL MODELS FOR ENVIRONMENTAL EDUCATION

A variety of structural models can be used in describing environmental education. Nine models are identified herein as being of value. Four of these have been discussed previously[1]:

- Mission Model
- Content Model
- Learning System Design Model
- Operating Model

The Mission Model was presented as an intent structure for environmental education, showing the various learning outcomes sought and how these are related to each other. Some of these learning outcomes were targeted to the individual's benefit, while others were targeted to the society's benefit.

The Content Model showed the major components of environmental education: natural surroundings, built environment, population, pollution, energy, resource allocation and depletion, conservation, transportation, technology, economic impact, urban and rural planning, and the relation of the foregoing to the total human environment.

+ Part of this work was sponsored by the Office of Environmental Education, HEW, under Contract 300-700-4028. Comments by Mr. Walter Bogan were very helpful in preparing this paper.

The Learning System Design Model consisted of an Options Field and a process for using the Options Field to develop a conceptual design of a learning system for environmental education.

The Operating Model shows the six major activity classes: planning, learning system design, personnel development, learning activities, delivery system and support activities, and evaluation. The Operating Model provided substantial detail in each of these areas.

Three of the additional models to be introduced in this paper relate directly to the application of values in system design. These are:

- Decision Levels Model
- Decision Areas Model
- Values Model

The Decision Levels Model identifies six decision-making levels in the educational system. The Decision Areas Model identifies four major areas in which key decisions are made in the educational system. The Values model identifies the values basis that is proposed for use in educational system design.

Another model, called the Integrating Model, is designed to show how the seven models (discussed previously in this section) are related to each other.

Finally, the Implication Model is designed to show the requirements for environmental education. We shall discuss this model first, to provide background for the other discussions.

IMPLICATION MODEL FOR ENVIRONMENTAL EDUCATION

Environmental education is an innovation. Every innovation develops in stages. Support for and allegiance to an innovation often is small at first. Until certain primary requirements are met, an innovation cannot go beyond the first stage. After these primary requirements are met, an innovation typically enjoys increased support. What are the primary requirements for environmental education?

There are three primary requirements that environmental education must satisfy before it can go beyond the first stage of its evolution. They are:

A. Environmental education must be conceived so as to be consistent with education in a democracy
B. Environmental education must be understood as being associated with a content, i.e., a recognizable body of knowledge that lends substance and uniqueness to it
C. It must be established that the content is learnable through study, and the content must be disaggregated to correspond with position in time in the curriculum as a part of establishing who can learn what at what time in their development.

Consistency with education for democracy is needed to enable environmental education to gain the popular support that is needed to finance it. Also consistency is needed to allow it to be competitive for time in the curriculum with more established subjects.

A content is needed to lend professional credibility to the field, so that its practitioners are not handicapped by comparison with others who enjoy the status of being associated with a recognized body of knowledge. Unless a content can be clearly identified, necessary personnel cannot be attracted to this field. People will not commit themselves in large numbers to the development of the field, nor will they perceive or pursue careers in it to the extent necessary for its evolution into advanced stages.

Consistency and content are not sufficient unless it can also be established that the content is learnable by students at various stages in their development. If the content is demonstrated to be learnable, it may be positioned within the curriculum and thereby become institutionalized as part of the educational system.

Even these three primary requirements are by no means sufficient to guarantee success for environmental education. These requirements imply other requirements which also must be met. Environmental education will be judged by standards that go beyond those applied to many other subjects. The environmental field is one that has made headlines with demonstrations, advocates, and controversy. Environmental disasters are reported in daily newspapers and on television. When you hear the word "environment", it does not evoke images of Mr. Chips teaching his class, but rather it evokes images of controversy.

Establishing Consistency With Education in a Democracy

To establish consistency with education in a democracy, it will be necessary to couple environmental education very strongly with a sound educational philosophy with visible values, and to assure that these values are relatable to educational decision making and acceptable to the public and to educators.

Associating Environmental Education with Content

It is recognized that environmental education is interdisciplinary in nature and that, for it to be effective, it must lead to breadth of comprehension of interrelationships among numerous components. This means that it must draw upon other disciplines for some of its content. Moreover, to be realistic, it must be highly correlated with what is going on in the world around us.

The interdisciplinary nature of environmental education immediately translates into an institutional problem. Institutions of education are organized around disciplines, and that is what makes it possible to administer these institutions. Otherwise there would be chaos in such matters as assigning responsibility and measuring performance, not to mention personnel hiring and development.

If environmental education is to find a place in the educational institutions, there must be some way to distinguish it sharply from the disciplines. Still it must share certain features of the disciplines that account for their staying power.

However distinguished from the disciplines, environmental education must provide clear career opportunities for scholars, not only in teaching but also in research. Without this there is no path to content evolution, and without the latter the field will become stagnant and unattractive.

Establishing Learnability and Curriculum Position

At the present time, there is very little to go on in establishing learnability of interdisciplinary subjects because of their paucity and the lack of research in this area. While field demonstrations would be very valuable as a means of establishing learnability, such demonstrations require resolution of content issues.

There is, however, a substantial amount of good research related to human learning capability. This research, we believe, is the best currently available source of guidance for establishing learnability, and for providing very rough guidance concerning curriculum positioning. While the available research seems to be somewhat controversial, there is a considerable amount of evidence to show that concerning learning relationships among a sizeable set of elements, these conditions apply:

- People are generally not very capable when it comes to working mentally with more than five or six concepts at a time. It is only after they have been able to explore systematically the relations among several concepts that they can reconceptualize the learning so that the array of related concepts takes on the image of a single concept. This approach to organizing knowledge has been called "chunking" in the literature.
- Skill at chunking is slow to develop, and only begins to be manifested around the age of twelve.

There is substantial field evidence to show that the capacity of people to work (together or separately) with many more than five or six concepts at a time can be very greatly enhanced if a computer is used to assist them to keep track of the relationships that are being studied. The computer helps people to organize information into chunks, and even provides them with the structure of the chunk, based upon their own fragmentary contributions to it.

Implied Requirements

In considering the foregoing primary requirements we conclude that a number of implied requirements are present. Possible means of achieving these requirements have been identified.

With regard to a suitable set of values, the educational philosophy of Ralph Barton Perry, as set forth by Steinberg[2], is highly recommended. We will present a set of values extracted from the Perry philosophy as a basis for incorporating values in educational system design.

With regard to content, we conclude that an embracing context that can meet content requirements is the context of human settlements. This context meets the requirements discussed earlier, and it is broad enough to include all of the components of environmental education mentioned earlier. Moreover it can be related by the student to personal surroundings and thus correlated with individual lives. In addition, a fledgling science of human settlements already exists as a potential base for further development in the "ekistics" developed by C. Doxiadis.

By using computer assistance and taking structural model building as the basis for learning, interdisciplinary requirements can be accommodated and the demonstrated difficulties of coping with relations among many elements can be overcome. However in view of what is known about the stages of human development, this type of education should probably be confined to middle school, high school, and college.

Use of the computer as a learning aid in developing relation models requires the skill of a facilitator along with modification of the classroom environment. That this process can be used in the classroom has already been demonstrated, and teacher acceptance was indicated[3].

Institutional support would clearly be needed for changes of the type we have mentioned. In order to qualify for such support, it seems clear that there will be a period during which learning system design will have to be carried out to accommodate to the requirements of environmental education. Also there will have to be personnel and materials development. The role of the teacher will have to be reconceptualized. The use of classroom resource persons, acquainted with human settlement characteristics, including long-range plans developed by local or regional planning agencies, will add valuable information to the learning experience. Finally demonstration projects will be necessary to work out details and to provide credibility.

The Implication Model in Figure 1 summarizes the foregoing.

INTEGRATING MODEL

As mentioned, several models have been developed for environmental education. Figure 2 is an Integrating Model intended to show how seven of the models are related in terms of the flow of information.

At the base of the Integrating Model is the Value Model, to be discussed. This model informs all of the other models.

The Mission Model is informed by the Value Model. Together with knowledge of the Content Model, it forms a basis for the conception of a learning system design. A basis for learning system design is provided in the Learning System Design Model. This Model is also informed by research on human development, having to do with what people can learn at what stages. Constraints also bear on this Model.

The Operating Model and Decision Area Model are informed by the models lying below them. Also these two models inform each other.

The Decision Level model is informed by all models lying below it in the structure.

As we proceed, our main interest will be in the connection between the Value Model, the Decision Area Model, the Decision Level Model, and the Operating Model.

In order to develop the connections, we shall elaborate on the Decision Area Model and the Decision Level Model. The Operating Model has already been discussed in detail in the literature[4].

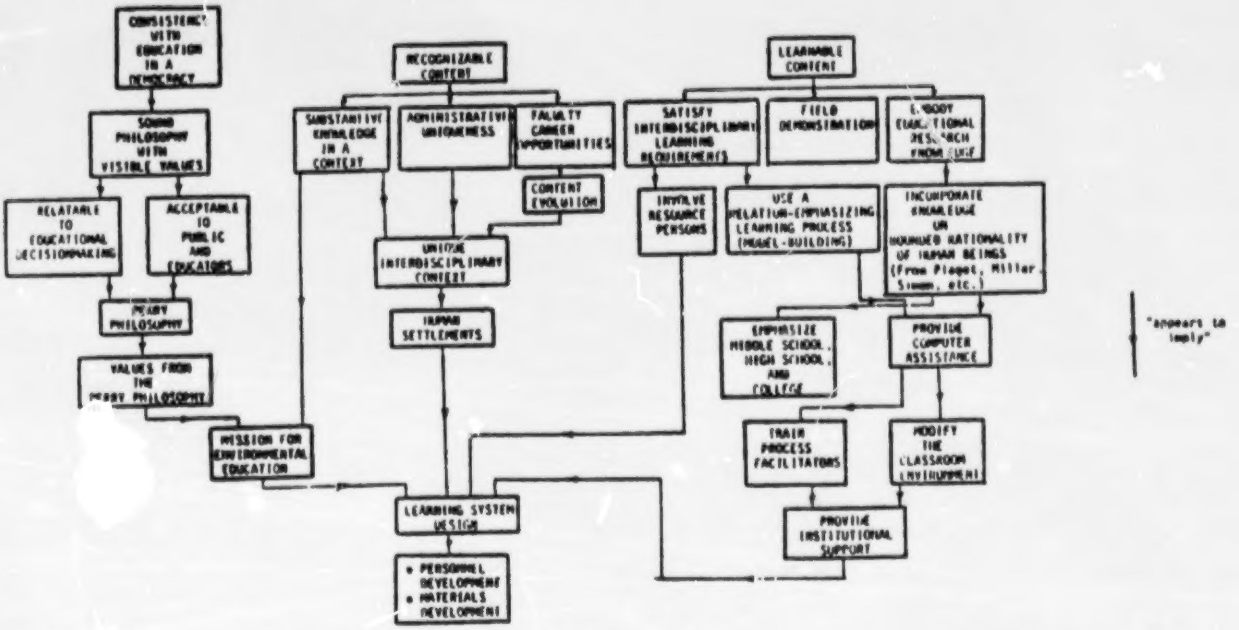
CONSISTENCY WITH EDUCATION IN A DEMOCRACY
SOUND PHILOSOPHY WITH VISIBLE VALUES
RELATABLE TO EDUCATIONAL DECISIONMAKING
ACCEPTABLE TO PUBLIC AND EDUCATORS
PERRY PHILOSOPHY
VALUES FROM THE PERRY PHILOSOPHY
MISSION FOR ENVIRONMENTAL EDUCATION
RECOGNIZABLE CONTENT
SUBSTANTIVE KNOWLEDGE IN A CONTEXT
ADMINISTRATIVE UNIQUENESS
FACULTY CAREER OPPORTUNITIES
CONTENT EVOLUTION
UNIQUE INTERDISCIPLINARY CONTEXT
HUMAN SETTLEMENTS
LEARNING SYSTEM DESIGN
• PERSONNEL DEVELOPMENT
• MATERIALS DEVELOPMENT
LEARNABLE CONTENT
SATISFY INTERDISCIPLINARY LEARNING REQUIREMENTS
FIELD DEMONSTRATION
EMBODY EDUCATIONAL RESEARCH KNOWLEDGE
INVOLVE RESOURCE PERSONS
USE A RELATION-EMPHASIZING LEARNING PROCESS (MODEL-BUILDING)
INCORPORATE KNOWLEDGE ON BOUNDED RATIONALITY OF HUMAN BEINGS (From Piaget, Miller, Simon, etc.)
EMPHASIZE MIDDLE SCHOOL, HIGH SCHOOL, AND COLLEGE
PROVIDE COMPUTER ASSISTANCE
TRAIN PROCESS FACILITATORS
MODIFY THE CLASSROOM ENVIRONMENT
PROVIDE INSTITUTIONAL SUPPORT
"appears to imply"

Figure 1. IMPLICATION MODEL FOR ENVIRONMENTAL EDUCATION

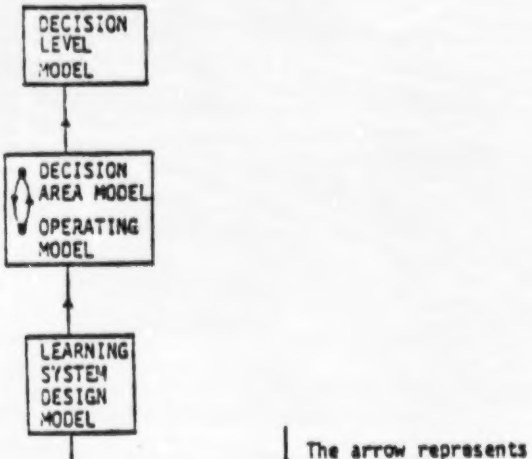
DECISION LEVEL MODEL
DECISION AREA MODEL
OPERATING MODEL
LEARNING SYSTEM DESIGN MODEL
CONTENT MODEL
MISSION MODEL
VALUE MODEL
The arrow represents "informs"

Figure 2. INTEGRATING MODEL

VALUES, DECISION LEVELS, AND DECISION AREAS

Values are applied within decision levels to decision areas. The considerable difficulty in working with values is partly alleviated by being selective. Selectivity, in our context, relates to the emphasis given to just a few decision areas. Likewise, emphasis is given to the kinds of values that are often obscured in system design in deference to more immediate concerns.

Value Model

Figure 3 shows the Value Model adopted for this study of environmental education. In developing this model, the approach taken was to use the Perry philosophy as set forth by Steinberg[2] as a basis, and to proceed as follows:

a) extract from the philosophy what appear to be the values contained in it
b) classify these values in terms that suggest how they relate to environmental education

The classification involves five categories, these being: (a) context-related, (b) relational, (c) people-related, (d) content-related, and (e) process-related.

The only value in the context-related category is a democratic political system. The educational system is perceived to reside in that context, and the rest of the values correlate with it.

Likewise there is only one value in the relational category, and that is the value of relating individual interests to the interests of others and, in general, to the society in which the individual exists.

The people-related values have to do with how people are perceived in the democratic context, and especially with the presumption of their capacity and obligation to play a role in the evolution of the society.

VALUE MODEL

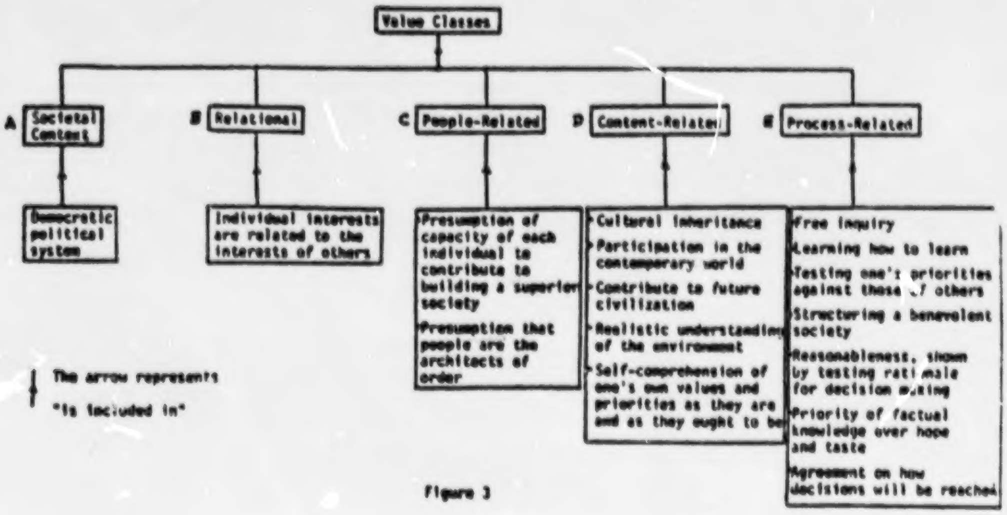
Value Classes
A Societal Content
B Relational
C People-Related
D Content-Related
E Process-Related
Democratic political system
Individual interests are related to the interests of others
Presumption of capacity of each individual to contribute to building a superior society
Presumption that people are the architects of order
Cultural inheritance
Participation in the contemporary world
Contribute to future civilization
Realistic understanding of the environment
Self-comprehension of one's own values and priorities as they are and as they ought to be
Free inquiry
Learning how to learn
Testing one's priorities against those of others
Structuring a benevolent society
Reasonableness, shown by testing rationale for decision making
Priority of factual knowledge over hope and taste
Agreement on how decisions will be reached
The arrow represents
"is included in"

Figure 3

The content-related values have to do with knowledge outcomes sought from education in general, including environmental education.

The process-related values have to do with the spirit and style with which education is conducted and with the means whereby the content is assimilated and interpreted by the learner.

By associating specific values or value classes with particular decision-making levels, and with particular decision areas, the role of values in educational systems design can be clarified.

DECISION AREA MODEL

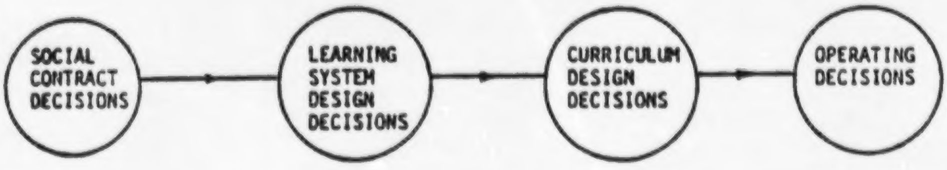
SOCIAL CONTRACT DECISIONS
LEARNING SYSTEM DESIGN DECISIONS
CURRICULUM DESIGN DECISIONS
OPERATING DECISIONS
The arrow represents
"informs"

Figure 4 DECISION AREA MODEL

Decision Area Model

Figure 4 shows the Decision Area Model. This model reflects four major decision areas in education, and indicates the flow of information. The four areas are:

- Social contract decisions, relating to the way in which the institution and the society interact, which determine the mission of educational institutions and affect the makeup of delivery systems and the support that is provided for education.
- System design decisions, relating to how the learning system is to be designed to make education effective, the choices that determine system design, and the way in which research knowledge is applied in configuring the system
- Curriculum design decisions, relating to how the curriculum is determined, what its content shall be, how learning shall take place, what contexts shall be selected for the learning, and what processes will be used to facilitate the learning experience
- Operating decisions, providing the basis for day-to-day and year-to-year management consistent with the mission, the learning system design, the curriculum design, communication across decision-making levels within the system, and the linkages in the operating model of education.

The Perry values appearing in the Value Model (Figure 3) appear to relate most closely to the Social Contract decisions and to the Curriculum Design decisions. The Societal Context, Relational, and People-

Related value classes relate directly to the Social Contract decisions. The Content-Related and Process-Related values relate directly to Curriculum Design decisions.

Values alone do not determine System Design decisions. In addition to values, such matters as availability of specific options, impact of various constraints, access to specific kinds of resources, and other factors also influence design. Yet the Process-Related values in the Perry philosophy correlate closely with the need to develop a capacity to help individuals work with complex relations[5], of which environmental education involves many as the Content Model[1] indicates. The values also correlate with Bateson's comments[6] concerning the importance of education that develops patterns and with Piaget's remarks that "the first task of education is to form reasoning: and that (insofar as mathematics becomes involved in studying environmental content) all mathematical ideas begin by a qualitative construction before acquiring a metrical character"[7].

The System Design decisions are certainly heavily influenced by the Social Contract decisions. The mission for environmental education flows from these decisions. The System Design decisions have been organized in the form of an Options Field[1]. These decisions necessarily involve common management values of effectiveness and efficiency, and when the System Design decisions and Curriculum Design decisions are implemented, the Operating decisions can be guided, in part, by the normative model for environmental education[4] which incorporates both the Mission and the Operating Models for environmental education.

Now we turn to the decisionmaking levels in the educational system, where the decision areas are an object of concern.

Decision Level Model

The educational system has been described by Atkin[8] as a system having six decisionmaking levels in an inclusion structure. A similar hierarchical pattern has been described by Banathy[9], who elaborates on the levels in more detail than we can supply here. The six levels are: the society, the institutional level, the administration, the instructional level, the learning experience level, and the individual level.

These levels are presented in the Decision Level Model in Figure 5. Persons at each of these levels make decisions that involve reference to values, implicit or explicit, knowingly or intuitively. These levels focus the general kind of decision making that goes on. It can be assumed that decisions at all levels are influenced by values. The details of value relationships vary from level to level, which is why the Decision Level Model is relevant. It affords a way to disaggregate decisions by reference to the different responsibilities or concerns that are evidenced naturally at the different levels.

A FRAMEWORK FOR VALUES ANALYSIS

We present next a framework for values analysis. A values analysis is an exploration into how various decisions may be referred to one or more of the value classes identified in the Value Model, with reference to particular levels in the educational system.

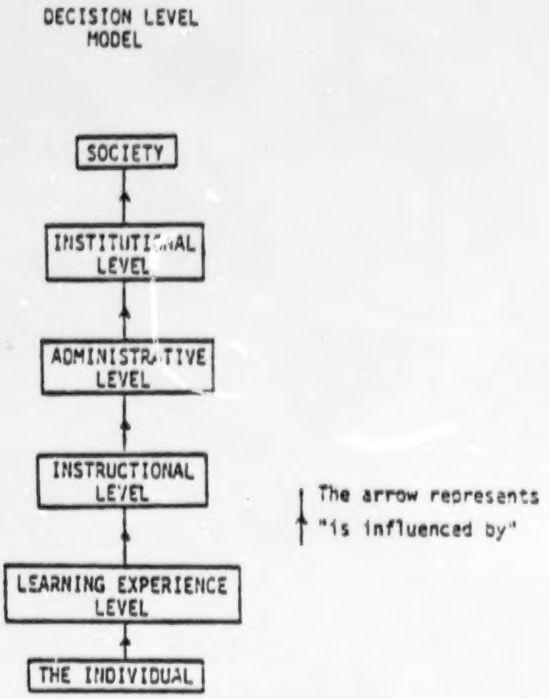

Figure 5

Social Contract Decisions

Table 1 illustrates the general mode of presentation of the framework for values analysis. This table lists major types of decisions associated with one of the decision areas from the Decision Area Model. With each decision type, we associate a particular level from the Decision Level Model, and then we associate specific classes of values from the Value Model with the decision and the decisionmaking level.

TABLE 1

TYPES OF SOCIAL CONTRACT DECISION	DECISION LEVELS	VALUE CLASSES
Choice of Value Model	1,2	A,B,C,D,E
Choice of Mission Model	1,2	A,B,C,D,E
Delivery Systems	1,2	A
Support	1,2	A,B,C,D,E
Evaluation	1,2	D,E

The most basic decision in the Social Contract category is the choice of value model itself. The Perry philosophy is sufficiently broad and definitive that it provides a value basis even for choosing some different value model which may be one of the best reasons for electing the Perry philosophy as a basis for a value model.

The choice of mission model clearly would be strongly connected with the choice of a value model, and would be expected to be strongly tied to all of its components. With the Value Model we have defined, it is thought that every class of value from the model is relevant to the Mission Model.

Delivery systems generally relate less directly to values, and involve other considerations than those in the Value Model, still they would reflect the democratic context. Support, one supposes, involves decisions concerning how well the system is relating to the selected value model, and thus involves potentially all of its components. Evaluation would probably focus upon content and process value classes.

System Design Decisions

System design decision types are taken from the dimensions of the Options Field which is the primary component of the Learning System Design Model. Table 2 presents the analysis.

TABLE 2

TYPE OF LEARNING SYSTEM DESIGN DECISION	DECISION LEVELS	VALUE CLASSES
Learning Outcomes Sought	1,2	D
Presumed Learning Style	1,2	E
Presumed Learner Skills Base	1,2	
Mode of Environmental Education	1,2	A,B,C,D,E
Type of Environmental Education	1,2	A,B,C,D,E
Mediator Model	1,2	D,E
Learner Interaction Resources	1,2,3,4	D,E
Sources of Information	1,2,3,4	D,E
Curriculum Delivery Concept	1,2	---
Origin of Financing	1,2	D

Curriculum Design Decisions

Curriculum Design Decisions relate to Social Contract Decisions and System Design Decisions, thus indirectly they are connected to the results in Tables 1 and 2. In Table 3 we present direct connections at other decisionmaking levels.

TABLE 3

TYPES OF CURRICULUM DESIGN DECISIONS	DECISION LEVELS	VALUE CLASSES
Context for Environmental Education	1,2,3,4	A,B,C,D,E
Content of Environmental Education	3,4	D
Position in the Curriculum	3,4	---
Process of Learning	3,4	C,D
Relationships Involved in Content	3,4	B,D

It will be recalled that we have recommended human settlements as the context for environmental education. This recommendation pertains to formal education only. In informal education, context would be built around issues, though in most other respects there would be parallelism between formal and informal education.

Relationships involved in content are generated within the disciplines, but in environmental education they need to be selected to illuminate the connections between the components of the Content Model.

Operating Decisions

Operating Decisions are strongly conditioned by the Social Contract Decisions, Learning System Design Decisions, and Curriculum Design Decisions, since these provide the longer term orientation that is required for making Operating Decisions. Table 4 lists types of Operating Decisions and relates them to the levels and value classes.

TABLE 4

TYPES OF OPERATING DECISIONS	DECISION LEVELS	VALUE CLASSES
Planning	2,3,4	A,B,C,D,E
Learning System Design	2,3,4	A,B,C,D,E
Personnel Development	2,3,4	A,B,C,D,E
Learning Activities	3,4	B,C,D,E
Decision Systems and Support	1,2	D,E
Evaluation	3,4,5,6	C,D,E

Exclusion of a value class from the tables is not meant to indicate irrelevance. Rather the more important value classes relative to a given type of decision are meant to be shown here.

USE OF THE FRAMEWORK IN SYSTEM DESIGN

The framework may be used in several ways in system design. First of all, study and discussion of the framework may provide system designers with a common approach and value base, which will allow design to proceed. Also direct value articulation may serve as a partial explanation of designs or design decisions. Second, the framework may serve to point toward specific considerations that should be made when system design is underway. Wherever difficulties or differences surface in making design decisions, the relevant value classes may be brought into the discussion and correlated with design options to the extent possible. Finally, the framework may be useful as a checklist against which existing or contemplated designs may be assessed.

CONCLUSIONS

The Perry philosophy provides an integrated basis for defining a set of values relevant to educational system design. By correlating values from this philosophy with types of decisions and decision making levels in an educational system, it is possible to establish an explicit connection between values and system design decisions.

Such a connection responds to a common complaint that values are not made explicit in design. More importantly, perhaps, a commonly-accepted set of values provides cohesion and direction to educational system design, and may make it a more respectable activity. Moreover the values themselves may serve to counter an apparent movement to judge everything in education in terms of tables of numbers.

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